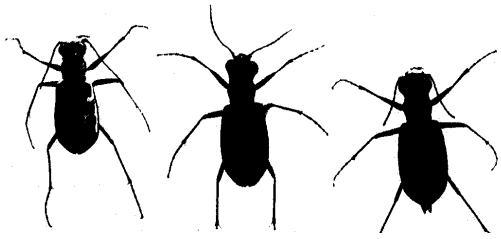
Conservation Biology Research Grants Program
Division of Ecological Services

Tiger Beetles (Coleoptera: Cicindelidae) as an Indicator Taxon of Environmental Quality in Minnesota State Parks

Annemarie R. Selness
Prairie Ridge Road
RR 2 Box 15
Caledonia, MN 55921

September 18, 1999



Tiger Beetles (Coleoptera: Cicindelidae) as an Indicator Taxon of Environmental Quality in Minnesota State Parks

ABSTRACT

Invertebrate inventories are becoming increasingly important for making resource related management decisions in park lands. Insects seem to be especially well suited for use as indicators of habitat conditions. The family of tiger beetles (Cicindelidae) is an excellent indicator taxon for determining environmental quality and patterns of biodiversity because of its stable taxonomy, understood biology, its tendency to be specialized within a narrow habitat, and it patterns of species richness are highly correlated with those of other vertebrate and invertebrate taxa. This project was developed to inventory the tiger beetles found in three Minnesota State Parks, to determine their associated habitat type using CBS data and to discover if patterns of diversity between tiger beetles, terrestrial breeding birds and butterflies existed.

INTRODUCTION

Since invertebrates make up the largest component of land diversity invertebrate inventories are being used for making resource management decisions in park lands. Sever time and funding limits are problems for many research programs. The majority of studies using indicator taxon has relied on vertebrates, especially species the public has taken an acute interest in.

Vertebrates tend to live long, have a low population increase rate, have long generation times and comparatively low habitat specificity. All of these things tax time and budgets. Recently, there has been an effort to overcome thee problems by using insects, instead of vertebrates as indicators. For example, the family of tiger beetles (Cicindelidae), is an appropriate indicator taxon for determining patterns of biodiversity because (1) its taxonomy is unvarying (2) its biology and general life history are well discerned (3) individuals are easily observed (4) each species tends to dwell within a narrow habitat range and (5) patterns of species richness can be correlated with those for other vertebrate taxa. Additionally, tiger beetle specie numbers can be reliably determined within 50 hours on a single site, compared to months or even years for birds and butterflies.

To test the patterns of diversity, associations can be made between tiger beetle species, numbers of terrestrial breeding birds, and butterfly species. Correlation coefficients can be calculated between taxa for each park. In terms of the advantages of working with tiger beetles (less time and funding needs) the disadvantages of some loss of

detail in constructing patterns of species richness will be offset. Additionally, because of tiger beetles preferences for specific habitats and their presence in the predator trophic level, they are likely to be highly vulnerable to habitat changes.

METHODS AND MATERIALS

This tiger beetle project took place in three separate Minnesota State Parks. Beaver Creek Valley State Park in Caledonia, Forestville State Park in Preston and Lake Louie State Park in LeRoy. Tiger beetles were surveyed throughout these parks by walking park trails, riparian areas and grasslands. Tiger beetles prefer these habitats. At each location where tiger beetles were observed the beetle was immediately identified and the location marked on a map. Habitat type was also noted at this time.

Fifty hours were spent in each park between May and August in 1998 and 1999. If a species was to be collected it was swept up in an aerial net and placed in a collecting tube for pinning and labeling at a later date. Each site was surveyed six times per season for 4-5 hours at a time for a total of 25 hours each season. See Table 1.

Forestville and Beaver Creek Valley State Parks are located in the Blufflands landscape region of southeastern Minnesota. Lake Louise State Park is located in the Oak Savanna Landscape region. Forestville and Beaver Creek Valley are covered by deciduous forest with the most common trees including oak, basswood, sugar maple, ironwood, elm, ash, black walnut, and hickory. Both parks have small prairie remnants remaining. Lake Louise State Park contains deciduous forest and old field land. The deciduous forest contains primarily red and white oak, maple, basswood, ash and aspen. The old fields are primarily grasses but are slowly returning to prairie species. All three parks have rivers or creeks running through them which provide riparian areas for shore species of tiger beetles.

The total number of beetle species, breeding bird species and butterfly species for each park was determined using CBS data and Selness and DelGreco butterfly survey information. This information was used to test patterns of diversity by looking at any associations made between tiger beetle, bird and butterfly species. Results were calculated between parks.

RESULTS AND DISCUSSION

No single species or taxa can be expected to represent biodiversity patterns for all other species. Butterflies, because of their well-known biology and systematics have served as the most widely-used insect group for conservation studies. To answer some questions, alternative insect taxa such as the Cicindelidae may be a more appropriate indicator taxon for determining patterns of biodiversity.

Four species of tiger beetles were found in three Minnesota State Parks from May through August 1998 and 1999. The most common species observed was Cicindela sexguttata. the Six-Spotted Tiger Beetle. This is a strikingly beautiful metallic blue-green beetle which also includes and impressive purple color variation which was found and collected in Forestville State Park.. This color variation had not been reported in Minnesota before (Ron Huber, personal communication). C. sexguttata is primarily a spring species with a 2-year life cycle. It is a generalist (found in all three parks)in woods, on logs and stones, along dirt and sandy roads, trails and paths. In most of the United State it is considered to be typical of deciduous woods.

Cicindela repanda or the Common Shore Tiger Beetle was found at Lake Louise and at Beaver Creek Valley State Parks. This is a common greenish-brown species with full maculations. It is a spring-fall species common throughout the summer. This species is also a generalist found in a variety of habitats, but most abundant near water. C. repanda was very abundant on the beach and along the shoreline at Lake Louise State Park. It was found on the artificial sandy beach area at Beaver Creek Valley State Park in 1998, but could not be relocated in 1999. This was probably due to significant disturbance to the beach area by reshaping and blading the sand. This beetle should recolonize this area in the future if disturbance is kept to a minimum.

Cicindela duodecimguttata, or the 12-Spotted Tiger Beetle was found at Lake Louise State Park sharing the beach area with C. repanda. These beetles are dark brown to black above and the elytral maculations are broken forming spots. This is a spring-fall species occupying wet habitats along wooded rivers. It usually prefers somewhat drier ground than C. repanda.

The Punctuated Tiger Beetles, Cicindela punctulata. was only observed once in two seasons at Forestville State park and was not collected. This is a small, slender black-brown species with tiny white maculations. Adults emit a fruity odor when handled. This species is a generalist on bare soil especially in cultivated or human disturbed land with hard-packed soil. It was observed in the picnic area at Forestville. This is the species that would most likely be found in a suburban back yard.

Two beetles species were observed at Forestville, C. sexguttata and C. punctulata. Two species were observed at Beaver Creek Valley, C. sexguttata and C. repanda, . Three species were observed at Lake Louise, C. sexguttata, C. repanda, and C. duodecimguttata. Using available data, correlation coefficients were calculated for each park. Correlation coefficients were nonsignificant between tiger beetles, breeding birds and butterfly species numbers in these state parks. $F(2,2) = 7.37$ $p<.05$. R value was .66. The reason for the nonsignificance could be small sample size.

CONCLUSIONS

Tiger beetles were inventoried at three Minnesota State Parks. Patterns of diversity between tiger beetle species, terrestrial breeding birds and butterflies were determined and a collection was made of three of the four species observed. Only one beetle, the purple color variation of C. sexguttata is being sent to the Entomology Museum in St. Paul since this is the only new find for Minnesota.

This study indicates that an indicator taxon is ultimately selected on the basis of compromise. The small number of tiger beetle species is likely to result in some loss of detail in constructing patterns of species richness. Correlations between tiger beetles, butterflies and bird species did not appear in this study. However, the tiger beetles' specialization of habitats and their presence in the predator trophic level make them highly susceptible to habitat changes as was demonstrated by the loss of C. repanda at Beaver Creek Valley State Park.

In Minnesota State Parks tiger beetles can be used to determine habitat disturbances. Habitat destruction and degradation, such as trail upgrades and new facilities are a big threat to beetle populations and survival. A thorough survey of these areas prior to improvements should be conducted.

Future research should include the identification and presence of tiger beetle larvae. Presence of larvae show that a reproducing population is locally established. In many species, adults can disperse great distances, but then may die without reproducing. Therefore, the presence of larvae means a viable population is present. As suggested by Ron Huber, future research could also include a revision of the subspecies for C. sexguttata. Additionally, mapping would be more accurate using a GPS unit.

TABLE 1

LOCATION	DATE	SPECIES OBSERVED
Forestville	5-04-98	C. sexguttata
	5-26-98	C. sexguttata
	6-17-98	C.sexguttata
	7-09-98	C.sexguttata
	8-11-98	None
	5-26-99	C. sexguttata
	6-07-99	C. sexguttata
	6-16-99	C. sexguttata
	6-22-99	C. sexguttata
	7-09-99	C. sexguttata, C. punctulata
	8-05-99	None
Lake Louise	4-28-98	C. repanda
	5-18-98	C. repanda, C. sexguttata
	5-29-98	C. repanda, C. sexguttata
	6-12-98	C. repanda, C. sexguttata
	7-10-98	None
	8-11-98	C. repanda, C. sexguttata
	5-16-99	C. repanda, C. duodecimguttata
	5-28-99	C. repanda, C. duodecimguttata
	6-11-99	C.sexguttata
	6-20-99	C. sexguttata, C. repanda
	7-02-99	C. sexguttata
	8-05-99	None
Beaver Creek Valley	5-11-98	C. repanda, C. sexguttata
	5-29-98	C. sexguttata
	6-16-98	C. repanda, C. sexguttata
	6-23-98	C. sexguttata
	7-06-98	None
	8-13-98	None
	5-19-99	C. sexguttata
	6-03-99	None
	6-15-99	C. sexguttata
	6-29-99	C. sexguttata
	7-10-99	C.sexguttata
	8-15-99	None

REFERENCES

Coffin, B., & Pfannmuller, L. (Eds.). (1988). Minnesota's endangerad flora and fauna. Minneapolis, MN:Universiiy of Minnesota.

Dawson, R W. & W. Horn. (1928). The tiger beetles of Minnesota. University of Minnesota Agricultural Experiment Technical Bulletin 56. 13pp.

Ginsberg, H. S. (1994). Conservation of invertebrates in U.S. National Parks. American Entomologist. 40, 76-79.

Kellert, S. R (1993). Defenders of Wildlife. Washington, DC: Island Press.

Kremen, C. (1993). Terrestrial arthropod assemblages: Their use in conservation planning. Conservation Biology. 7, 796-808.

LeConte, J. L. (1857). Revision of the Cicindelae of the United States. Transactions of the American Philosophical Society 11:27-64.

Leopold, A. (1966). A Sand County Almanac. New York: Ballantine.

Minnesota Department of Natural Resources. (1994). 1995-2000 Strategic Plan. St. Paul, MN: Author.

Minnesota Department of Natural Resources. (1994). Butterflies of Lake Louise State Park. (Report Number 1). Rochester, MN: Author.

Minnesota Department of Natural Resources. (1997). Butterflies of Beaver Creek Valley State Park. (Report Number 1). Rochester, MN: Author.

Murphy, D. D. (1992). Invertebrates and the conservation challenge. Wings. 16(3), 4-7.

Opler, P. A. (1987). Invertebrate surveys in North America are necessary. Wings. 12(2), 8-10.

Panzer, R, Stillwaugh, D., Gnaedinger, R, & Derkovitz, G. (1995). Prevalence of remnant dependence among the prairie- and savanna- inhabiting insects of the Chicago region. Natural , as Jo mal 15. 101-116.

Pearson, D. L. & F. Cassola. (1992). World-wide species richness patterns of tiger beetles (Coleoptera:Cicindelidae): Indicator taxon for biodiversity and conservation studies. Conservation Biology. 6(3), 376-391.

Selness, A. R. Citizen participation in a lepidopteran monitoring program: Its use in park lands. MS in recreation Management, December 1995.

White, R. E. (1983). A field guide to the beetles of North America. Boston: Houghton Mifflin Company.

Anne Selness
Prairie Ridge Road
RR 2, Box 15
Caledonia, MN 55921

Dear Ms Selness, 25 May 1999

Thank you for subscribing to the journal *CICINDELA*. The first issue (double: Mar/Jun) is headed for the printer and should be in the mail soon.

Caledonia brings back fond memories. Cathy and I have done much survey work for tiger beetles, butterflies, birds, etc. in that area (and I also buy books from Eric Theis at ZOO BOOK SALES).

Years ago, I got hung-up on a loop-road and couldn't seem to "escape." When I asked the local farmer where I was, he said, "Why, you're on Blackhammer Ridge." With some instruction, I found my way out ! Love that country.

Your solid purple, unmarked cicindelid is indeed *C. sexguttata*. I have seen that morph from scattered localities (and it can be semi-common in northcentral KS) but I don't recall seeing it in Minnesota. When it was first discovered along the Atlantic coast (in the late 1700's ?), Fabricius named it *C. violacea*. Subsequent authors referred to it from midwestern localities, but Warren Knaus ("Mr Coleoptera" of Kansas) realized that the spatial differences might suggest genetic dissimilarity, so he called the Onaga, .KS examples *C. kansanus*. Both names are usually regarded as synonyms of *C. sexguttata*.. The eastern populations of *sexguttata* are usually noticeably spotted, while our midwestern populations have reduced maculations or none at all. Casey first noted this, and named the midwestern examples *C. sexguttata tridens*. The subspecies concept has not been given much thought with regard to *sexguttata*. It might make a nice thesis topic for somebody to do a revision beyond that of Mike Kaulbars (*i.e*., electrophoresis, mitochondrial dNA, etc.). We enjoy-seeing them on the trails down here, but with the lure of *Amblycheila* and *C. pulchra* in western KS, well.....

One interesting recollection I have from Houston County is that, on rare occasion, we would find a BLUE specimen of *C. scutellaris lecontei*, mixed in with the usual bright green, olive, or wine-colored specimens. You have no doubt also found *C. limbalis, C. splendida*, and their putative hybrids on the steep, red clay embankments there. We have taken them there on warm sunny days as late as early November (for Minnesota, that's not, bad !).

Sorry for the long-winded, rambling.answer to your question about the purple guy!

Thanks again for your interest.

Ron Huber

BEAVER CREEK VALLEY STATE PARK

FACILITIES AND FEATURES

- 26 semi-modern campsites
- Dump station, showers, and vault toilets
- 16 rustic campsites
- 6 walk-in campsites
- Primitive group camp (100 capacity)
- Picnic grounds with 50 tables and an enclosed shelter
- 8 miles of hiking trail

LOOKING FOR MORE INFORMATION?

The DNR has mapped 45 of 51 separate areas of the state's recreational state and county lands with their recreational facilities.

Public Recreation Information Maps (PRIM) are available for purchase from the DNR gift shop. DNR headquarters, Minnesota state parks and major sporting and map stores.

Check it out - you'll be glad you did.

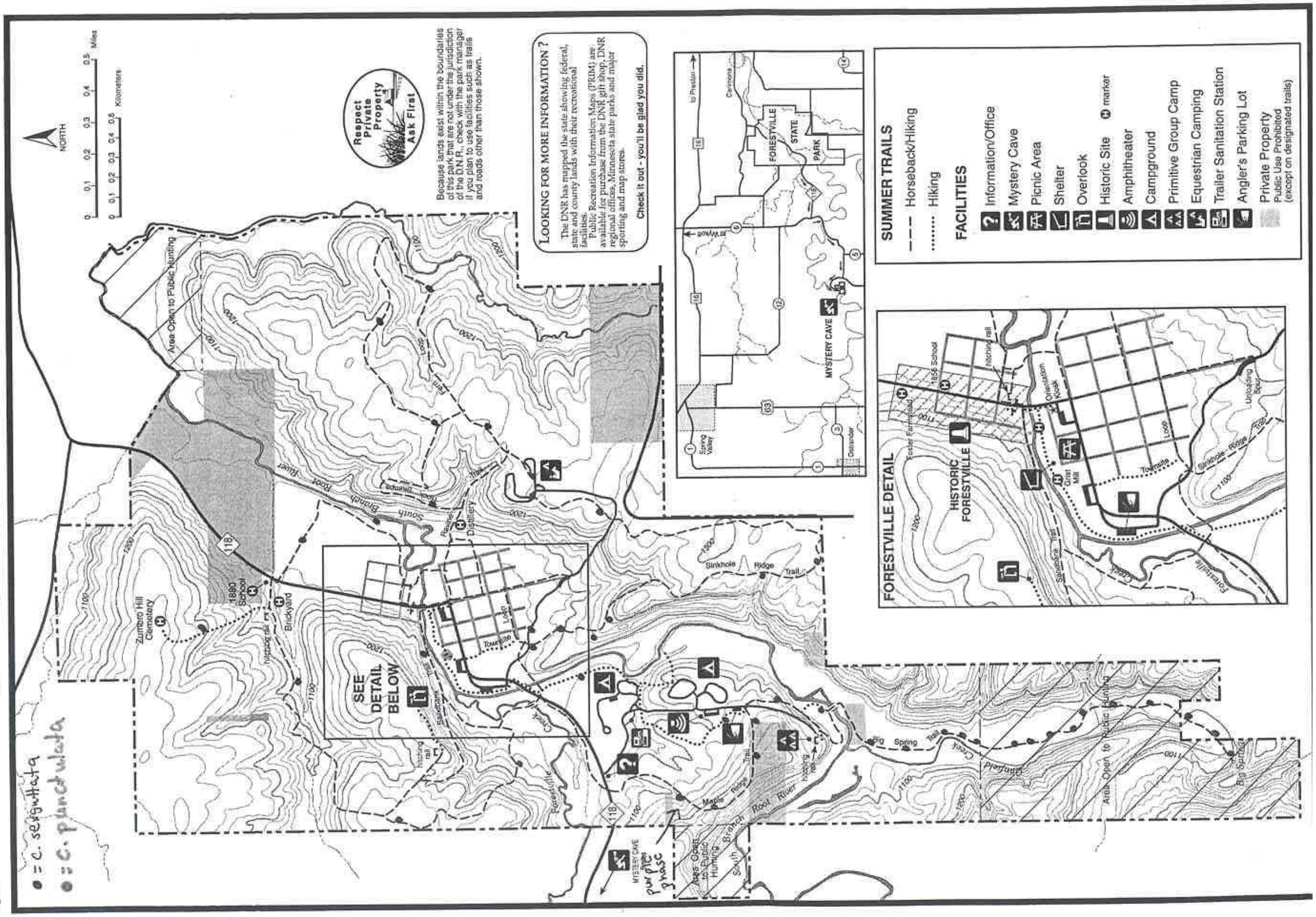
FORESTVILLE/ MYSTERY CAVE STATE PARK

FACILITIES:

- 73 semi-modern campsites (23 with electrical hookups)
- Dumping station, showers, and flush toilets
- Horseback riders campground (60 unit capacity)
- Main picnic area with an enclosed shelter and 60 tables
- Mystery Cave picnic area with an additional 15 tables
- 17 miles of hiking trail
- 15 miles of horseback riding trail
- 11 miles of skiing trails
- 5.5 miles of snowmobile trails
- Summer interpretive center with council ring
- Winter warming shelter

VISITOR FAVORITES:

- Mystery Cave
- Historic Forestville
  - Forestville Store & Post Office
  - Thomas & Mary Meighen Residence
  - Meighen Farm Buildings
  - 1899 Gillette-Hertzog Bridge
- Trout fishing
  - Canfield Creek
  - Forestville Creek
  - South Branch Root River
- Spring wildflowers and birding
- Big Spring (source of Canfield Creek)
- Other historic features



LAKE LOUISE STATE PARK

FACILITIES AND FEATURES

- 22 semi-modern campsites; 11 with electricity
- Primitive pioneer group camp—capacity of 100
- Horse campground—capacity of 50
- Trailer sanitation station
- Picnic ground with 30 sites and shelter building
- 11.6 miles of hiking trails
- 9.7 miles of horse trails
- 3.2 miles (5.1 kilometers) of cross-country ski trails
- 9.3 miles of snowmobile trails
- 1 mile of interpretive trail
- 1 mile of bike trail

VISITOR FAVORITES

- Lake Louise
- Lake and stream fishing
- Spring and summer wildflowers
- Bird watching
- White-tailed deer
- Swimming
- Horseback riding
- Picnic grounds overlooking Lake Louise

LOOKING FOR MORE INFORMATION ?

The DNR has mapped the state showing federal, state and county lands with their recreational facilities.

Public Recreation Information Maps (PRIM) are available for purchase from the DNR gift shop, DNR regional offices, Minnesota state parks and major sporting and map stores.

Check it out - you'll be glad you did.