

FOSSIL TIGER BEETLES (COLEOPTERA: CICINDELIDAE): REVIEW AND NEW QUATERNARY RECORDS

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INTRODUCTION

Fossil Cicindelidae are extremely rare in the stratigraphic record, probably due to the fragile nature of their exoskeleton. In this paper we summarize previous records and comment on new finds, as well as describe cicindelid specimens found in the southern California asphalt deposits which were noted, but not identified, by Pierce (1947a, 1947b).

SOUTHERN CALIFORNIA ASPHALT DEPOSITS

Both the well known McKittrick asphalt deposit in Kern County, California and the Rancho La Brea sequence, Los Angeles County, California, have produced identifiable cicindelid specimens. Pierce's specimens are deposited in the Natural History Museum of Los Angeles County (LACM). A fairly well-preserved specimen of *Cicindela haemorrhagica* LeConte (LACM Invert. Paleo. hypotype 4944) from the McKittrick asphalt deposit, retains complete markings on the elytra, and the elytral pleura still show a blue coloration similar to that of populations found along the sea coast of central San Diego County, California. A mandible (LACM Invert. Paleo. hypotype 4945) also from McKittrick, is probably a cicindelid but family placement is uncertain due to the poor condition of the specimen. Both McKittrick specimens were collected by L. Bessom from W. D. Pierce's "site 4" (LACM Invert. Paleo. Loc. 260), at a depth of 4 feet (1.3m) (Pierce 1947b, Miller and Peck, 1979). This site has not yet been radiocarbon dated, but a *Cybister* elytron taken from a depth of 3 feet (1 m) in the road cut at McKittrick has provided an

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experimental sample for a ^{14}C mass spectrometer run at Chalk River Nuclear Laboratory, Ontario, Canada. The resultant age of *ca* 8,000 yr B.P. suggests that the samples are probably of Holocene age, (Miller and Peck 1979, Morgan and Morgan 1980a) or of very late Pleistocene age as stated by Pierce (1947b).

Three *Cicindela* specimens are known from Rancho La Brea; two thoraces of *C. haemorrhagica* (RLP 8779E and RLP 9014E) and a metasternum of *C. oregona* LeConte (RLP 9465E). RLP 8779E and 9465E are from Pierce's "Bliss 29" material, which was collected in 1929 by W. Bliss from the sites of pits A, B, and C. The samples are probably late Pleistocene in age, but this is questionable due to unknown locality and possible contamination (Miller and Peck, 1979). RLP 9014E is from Pierce's "Pit X", which refers to mixed material, lacking data, and of questionable age.

The Quaternary presence of *C. haemorrhagica* and *C. oregona* in southern California is not unexpected. Both are presently widely distributed in fresh and marine littoral habitats in western North America. Although these two species are not narrowly restricted to specific microhabitats, they are always found near permanent sources of water.

NEW RECORDS OF FOSSIL CICINDELIDS ELSEWHERE IN NORTH AMERICA

Beside the above mentioned localities, a rekindled interest in the examination of coleopterous faunas has recently revealed fragments of cicindelids in a number of sites in the United States and Canada (Fig. 1). All but one of these records are more recent than the last review of North American fossil insects (Morgan and Morgan 1980b). The oldest specimen which is stratigraphically interpreted as pre last interglacial (pre-Sangamon) is a partial elytral fragment which is probably of the genus *Omus* from the Mountain View Dump site near Palo Alto, California (D. Adam pers. comm. 1978, Morgan unpublished). In the Pacific northwest, a recently examined site (Nelson and Coope, 1982) from Discovery Park, Fort Lawton, Seattle, has produced the remains of *Cicindela oregona* LeConte. A large and varied assemblage accompanies this find which is from sediments previously radiocarbon dated at between 23,000 and 18,000 yr. B.P. The site pre-dates the last major (Vashon) ice advance in the area and suggests a cooler climate with more open

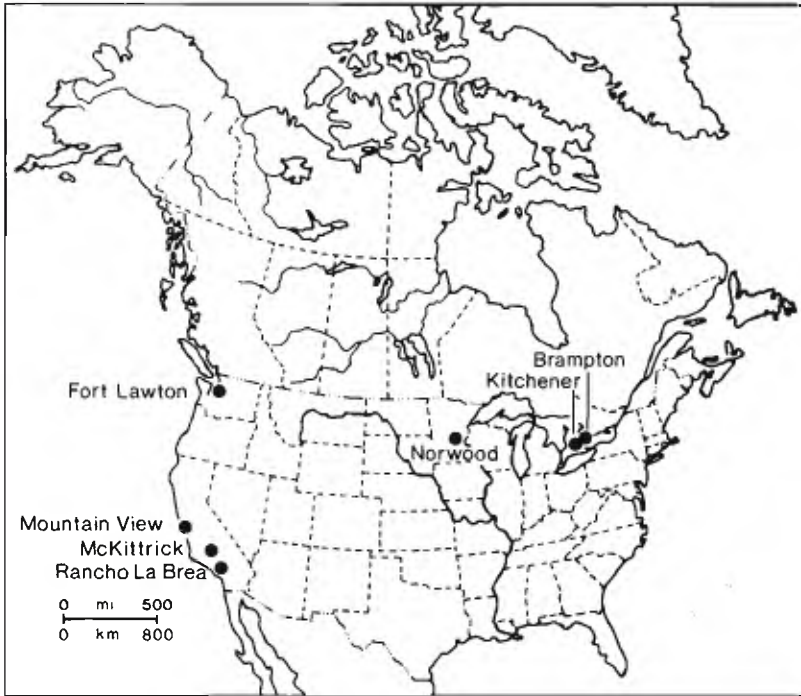


Figure 1. Location of North American sites mentioned in the text.

vegetation, an interpretation similar to that made from another 18,000 year old coleopterous assemblage from Port Moody in southern British Columbia (Miller, Morgan and Hicock, 1982).

In the central eastern section of the continent three sites post-dating the retreat of Laurentide ice have produced cicindelid remains. The Norwood site in Minnesota (Ashworth *et al.*, 1981) is a late-glacial kettle which has a sequence of silts overlain by peat dated at $12,400 \pm 60$ yr. B.P. (QL-1083). A left elytron of *Cicindela* cf. *C. sexguttata* Fabricius was recovered from the upper silt, an horizon characterized by a number of open ground beetle species. In the Canadian province of Ontario two sites at Kitchener and Brampton contain specifically identified cicindelids. The sites are approximately equivalent in age to the Norwood locality (*ca.* 12,400 to 12,000 yr. B.P.) and both slightly post-date the last major (Port Huron) ice readvance in the region. The Gage Street site, Kitchener,

produced a solitary, well-preserved mandible of *Cicindela repanda* Dejean from the basal level of a marl deposit (Schwert, 1978) found in association with open-ground but largely boreal species. The Brampton site near Toronto, is a kettle deposit from which a solitary well-preserved right elytron and mandible fragment of *Cicindela limbalis* Klug was recovered (Morgan and Freitag, 1982). Once again the cicindelid fragments were associated with a fauna resident today in open ground regions within the boreal zone (Morgan, Morgan and Motz, 1982).

The presence of cicindelids in these early deposits of late Wisconsinan sequences is not surprising. In all cases, with the exception of the California examples, the tiger beetle remains are associated with species which inhabit open ground situations. Undoubtedly the ice merely forced many cicindelid populations southward at the time of maximum advance and they remained there to successfully recolonise sandy terrain after ice retreat. Tiger beetle remains also are present due to the nature of the sediments; the very fine silts and clays which are typical of most of these sequences is ideal for the preservation of the extremely thin elytral chitin found in cicindelids. In coarse sediments, or in sequences which are organic-rich, the detritus would abrade, distort and fragment the remains to a degree where most skeletal parts would become unrecognizable.

In Table I, we have attempted to compile known fossil Cicindelidae records including those described in this paper, and we have also commented, where appropriate, on some of the early identifications.

Table I: Known Fossil Cicindelidae¹

Age	Deposit	Locality	Species	Reference
Eocene	Green River	USA: Colorado	<i>Cicindelopsis eophilus</i> Cockerell ²	Cockerell 1920
Oligocene	Baltic Amber		Cf. <i>Collyris</i> sp.	Larsson 1978
Oligocene	Baltic Amber		<i>Odontochila</i> sp.	Horn 1907
Oligocene(?) ³	Baltic Amber		<i>Megacephala carolina</i> Linnaeus	Horn 1906
Quaternary	Binagady brea	USSR: Caucasus Region	<i>C. lunulata</i> Fabricius, <i>C. campestris pontica</i> Fisch., <i>C. germanica</i> Linnaeus	Bogachev 1948
Quaternary	Fyzabad brea	Trinidad	<i>Megacephala</i> cf. <i>M. femoralis</i> Perty ⁴	Btair 1927
Pleistocene(?) ⁵	Port Kennedy	USA: Pennsylvania	<i>C. haemorrhagica</i> LeConte ⁶ ; <i>C. sp.</i>	Horn 1876
Pleistocene	Mountain View Dump	USA: California	<i>Omus</i> sp? ⁷	this paper
Late Pleistocene	Rancho La Brea	USA: California	<i>Cicindela oregona</i> LeConte <i>C. haemorrhagica</i> LeConte	this paper
Late Pleistocene	Seattle	USA: Washington	<i>Cicindela oregona</i> LeConte	Coope and Nelson, 1982
Late Pleistocene	Chelford ⁸	U.K: Cheshire	<i>Cicindela campestris</i> Linnaeus	Coope 1959
Late Pleistocene	Minworth ⁹	U.K: Warwickshire ⁷	<i>Cicindela</i> sp.	Coope and Sands 1966
Late Pleistocene	Low Wray Bay, Windermere ¹⁰	U.K: Westmoreland	<i>C. campestris</i> Linnaeus	Coope 1977
Late Pleistocene	Glanllynau ¹¹	U.K: Caernarvonshire ⁷	<i>C. campestris</i> Linnaeus	Coope and Brophy 1972
Late Pleistocene	Church Stretton ¹²	U.K: Shropshire	<i>C. campestris</i> Linnaeus	Osborne 1972
Late Pleistocene	West Bromwich ¹³	U.K: Staffordshire	<i>Cicindela</i> sp.	Osborne 1980
Late Pleistocene		U.K.	<i>Cicindela sylvatica</i> Linnaeus	Coope 1979

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Age	Deposit	Locality	Species	Reference
Late Pleistocene	Norwood	USA: Minnesota	<i>Cicindela</i> cf. <i>sexguttata</i> Fabricius	Ashworth et al., 1981
Late Pleistocene	Gage St., Kitchener	Canada: Ontario	<i>Cicindela repanda</i> Dejean	Schwert 1978
Late Pleistocene	Brampton	Canada: Ontario	<i>Cicindela limbalis</i> Klug	Morgan and Freitag, 1982
Holocène	McKittrick brea	USA: California	<i>C. haemorrhagica</i> LeConte	this paper

NOTES

¹Matthews' (1976 and 1977) record of a cicindelid mandible from the late Tertiary Beaufort Formation on Meighan Island has been reidentified as *Sialis* sp. (Neuroptera: Sialidae) larva (Matthews, pers. comm.).

²As suggested by Cockerell (1920), this may not be a cicindelid.

³Thought by Cockerell (1920) to be a fake.

⁴Originally reported as 'prope *viridis*' Tatum, now a synonym.

⁵The Port Kennedy mammal fauna is considered middle Pleistocene (Kurten & Andersen 1980), but stratigraphic relationships of the insects are unknown.

⁶Willis (1967) suggests this may be a misidentification of *C. rufiventris* Dejean.

⁷Because of county boundary revisions in many parts of England and Wales former counties (in text) have disappeared i.e. (Caernarvonshire in North Wales is now included in the new county of Gwynedd). Refer to original papers for national grid coordinates.

⁸ca. 70,000–60,000 yrs. B.P.

⁹ca. 32,000 yrs. B.P.

¹⁰ca. 13,000 yrs. B.P.

¹¹ca. 12,500 yrs. B.P.

¹²ca. 12,500–11,500 yrs. B.P.

¹³ca. 12,100 yrs. B.P.

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