ISRAEL JOURNAL OF ENTOMOLOGY VOL. XII 1978

A FOSSIL FLEA BEETLE (COLEOPTERA: CHRYSOMELIDAE) FROM LAKE HULEH, ISRAEL

David G. Furth

Department of Entomology, Faculty of Agriculture, Hebrew University, Rehovot, Israel

ABSTRACT

Examination of Pleistocene insect fossil fragments from a 54 meter core at the site of the former Huleh Lake (Upper Jordan River Valley, Israel) revealed a metafemur of a flea beetle of the genus *Longitarsus* (Coleoptera: Chrysomelidae). The genus was determined using a new identification technique based on intergeneric morphological differences in the flea beetle internal jumping aparatus — the metafemoral apodeme. After detailed comparison to many present-day species from the region, it is suggested that the fossil metafemur is attributable to *Longitarsus pratensis* (Panzer) because of similarities in color, size, and shape. This species is a *Plantago* feeder. There is paleoecological significance to this fossil beetle, even though it is rather recent (800 Y.B.P.), since it correlates with the peak of the pollen diagram for *Plantago* in this Huleh core in the park-like of oak-olive-pistachia. · This habitat has been mostly eliminated in the modern day Huleh Valley due to more extensive human disturbances.

INTRODUCTION

In recent years there has been an increasing amount of research in Pleistocene and some tertiary paleoecology using fragments of fossil (subfossil, i.e. actual pieces of chitin) insects as indicators of past ecology and climates. The majority of this type of paleoecology has been done by G. Russell Coope (1967, 1971), his associates (A. Ashworth *et al.* 1972, J.V. Matthews, 1977 and A. Morgan, 1973) in the British Isles and North America. These studies have been done primarily with beetles (Coleoptera) because the nature of their hard bodies, especially the fore wings (elytra), allow their recovery from sedimented organic material. Because the evolution of Coleoptera has been slow (Coope, 1971, Matthews. 1977), species that can be recovered as fossils from Pleistocene deposits are conspecific with those of modern times and can often be determined by specialists to genus or even species. If the ecological parameters of such an extant species are known or can be discovered then one can reasonably assume that such parameters and limitations also existed for that species in Pleistocene times at the site of a particular deposit (Coope, 1971). Therefore, some beetles, expecially stenotopic species, can be quite sensitive indicators (often more so than pollen or plant macrofossils) of past environments; when their fossil fragments can be recovered and identified. Because most beetles are very mobile their dispersal and distribution responds rather quickly to changes in the environment and thus differences from their present-day biogeography may be revealed. Paleoecological interpretations are largely deduced from comparison with present-day geographical ranges that are limited by thermal conditions (Coope, 1967, 1971).

G.R. Coope and his colleagues have determined hundreds of species of Coleoptera from fragments recovered from various deposits. Because the determination of genera and species of these beetle fragments is often extremely difficult the assistance of Coleoptera specialists has usually been required. Even for specialists the task of identifying a species from fragments is not an easy one. Often the morphological distinguishing characters are on parts of the body that are rarely recovered from deposits, e.g. antennae, leg extremities, etc. However, if enough fragments of the head, thorax (with legs or elytra), and abdomen are recovered then often some determination is possible. This paper concerns a fossil insect fragment recovered from the Huleh Lake (Israel, Upper Jordan Valley) and its implications.

The Huleh Lake and Swamps were almost entirely drained from 1951-1956 (only a small preserve remains) causing great ecological changes in this rather unique aquatic habitat (Furth, 1977). The Lake was located in the northeastern extension of the Great Rift Valley that has served as a bridge for many tropical african faunal and floral elements that exist in this biogeographical crossroads of Europe, Africa and Asia (Furth, 1975). In 1963 a 54 meter core was taken at the site of the former Huleh Lake in order to decipher its history and development. This core has been studied in many paleoecological respects (Cowgill, 1969, 1973; Hutchinson and Cowgill, 1973; Racek, 1974; Olhorst and Hutchinson, 1977; and Olhorst, Shmida, and Hutchinson, in press). The studies of this core have re-

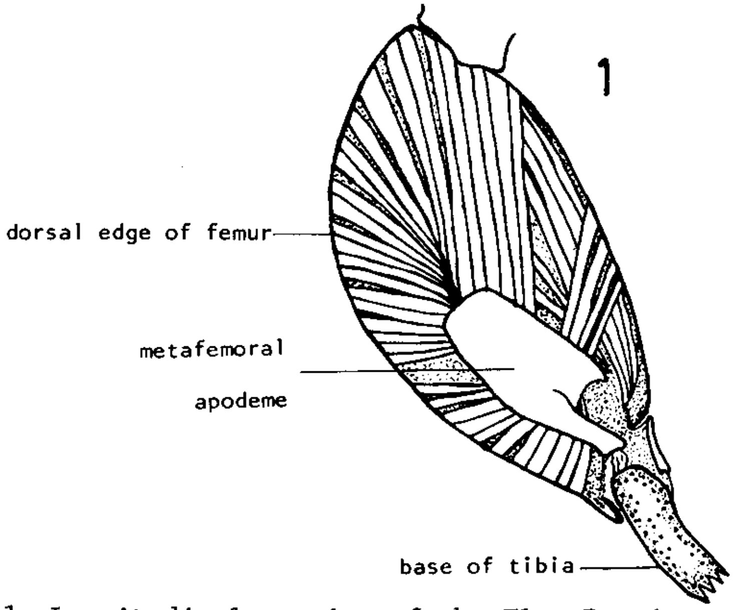

Fig. 1. Longitudinal section of the Flea Beetle metafemur (after Barth, 1954).

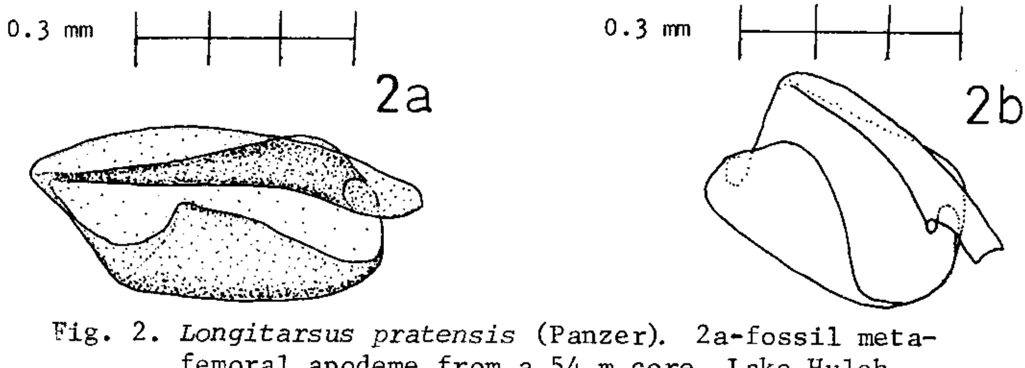

Fig. 2. *Longitarsus pratensis* (Panzer). 2a-fossil metafemoral apodeme from a 54 m core, Lake Huleh, Israel; 2b- three dimensional schematic of the metafemoral apodeme.

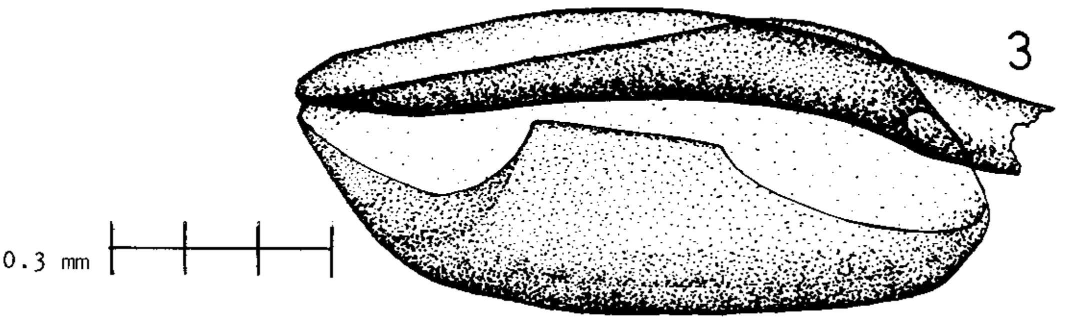

Fig. 3. *Longitarsus* nigrofasciatus (Goeze) - metafemoral apodeme, Mt. Meron September 10, 1973.

vealed many of the paleoecological changes of the region with some possible interpretations of human influence there. The author was asked to try to determine the insect fragments from this core.

The hind femur of a flea beetle (Chrysomelidae: Alticinae) was discovered amongst the insect fragments of this core. This is especially interesting because it offered an opportunity to test a new method for the determination of alticine genera using the inter-generic morphological differences of the sclerotized apodeme within flea beetle hind femora (Furth, in preparation[1]). Flea beetles are so named for their ability to jump like true fleas (Siphonaptera). This internal apodeme of the metafemur serves for attachment of the powerful hind leg muscles that enable the beetle to spring into the air. The exact mechanism of this jumping process is not accurately understood yet although theories have been presented (Barth, 1954; Furth, unpublished data). The similarities and differences of this apodeme among alticine genera appears to be very revealing evolutionarily (Furth, in prep.).

DISCUSSION

Fragmented insect material from the Huleh Lake core (54 m) was received after being separated into 1 dram vials according to their strata (in cms) in the core. A flea beetle hind femur (deposited in the Peabody Museum of Natural History at Yale University) was found in cm 108-111 of the core. It was easily recognized as such because of its swollen form and the internal sclerotized metafemoral apodeme (Fig. 1) which was visible through the chitinous femoral wall (the apodeme is often visible even in living specimens). This subfossil metafemur is light brown in color with the internal apodeme darker brown. While it seems possible that this subfossil's color may have been somewhat cleared, subfossils usually retain their color and are often darker (Matthews, 1977). Upon dissection and removal of the fossil metafemoral apodeme (Fig. 2), it was compared to figures and specimens of present-day Israeli alticine

---

1. Furth, David G. The significance and inter-generic differences of the flea beetle jumping mechanism (Coleoptera: Chrysomelidae). Submitted manuscript.

apodemes (Furth, in prep.) and it was concluded that this subfossil belonged to the genus *Longitarsus* (Fig. 3).

Although there are no external morphological traits of the metafemur to determine the specific rank within *Longitarsus*, it seems reasonable to attempt to narrow the possible species that fit the criteria of size, shape color, etc. of the subfossil specimen. Thus, such an attempt has been made using current knowledge of Israel *Longitarsus* (Furth, unpublished data) and comparative measurements of the metafemur (length of femur, length of apodeme, height of femur, ratio of femoral length to height) of most of the known *Longitarsus* in the Middle East. The subfossil measures .74 mm femoral length (Lf), .38 mm femoral height (dorsal to ventral edges) (Hf), .35 mm apodeme length (La). Its metafemoral shape (lateral view) is rather short and fat with a convex ventral border giving a swollen appearance.

Because the host plant ecology of each alticine genus is usually restricted to a few plant families, some information about former vegetation may be inferred. Although most present-day *Longitarsus* in the Huleh Valley region feed on Labiatae and Boraginaceae, a few eat plants in several other families: Scrophulariaceae; Plantaginaceae; Convolvulaceae; and Compositae. Therefore, narrowing the possible species identity of the fossil would be even more revealing paleoecologically.

The above-mentioned reasonable assumption that the subfossil has retained its approximate color, light brown or yellow, reduces the possibilities since *Longitarsus* may be generally divided into light and dark species. Many of the light species are Labiatae feeders. By considering also the comparative femoral measurements (Lf, Hf, La) and the shape (including Lf/Hf), most of the remaining light species can be eliminated. The Scrophulariaceae and Convolvulaceae feeders are too large. There are 8 species that are similar to the fossil, however, detailed examination of size and shape eliminate all but two. One of these is *L. lycopi* (Foudras) known from the present-day Huleh Nature Preserve feeding on *Mentha* and *Lycopus*. A recently collected specimen of *lycopi* measured Lf = .75 mm, Hf = .35, La = 35. However, very close comparison of this species with the fossil reveals a significant difference of shape in lateral view. The fossil is apparently wider in the middle, this is also revealed by the Lf/Hf ratio (usually constant within each species). The remaining species is conspecific with the subfossil. This is *Longitarsus pratensis* (Panzer) which feeds on *Plantago*. This beetle was originally known from the Central Coastal Plain of Israel (Sahlberg, 1913) and recently discovered in Hurshat Tal National Park in the Upper Galilee. Hurshat Tal was a religious Moslem cemetery that now preserves the oldest oaks (*Quercus ithaburensis* Decne.) in the region as well as *Pistacia atlantica* Desf. This Park has probably been disturbed relatively little by human development, for more than a thousand years, in comparison to most natural vegetation in the surrounding Huleh Valley. Hurshat Tal is near the edge of the former Huleh Lake and Swamps. Further searching may reveal *L. pratensis* in the present-day Huleh Nature Preserve.

Although this fossil is rather recent (600-800 YBP), its presence in the most recent period of the Huleh core correlates with the palynology of the core (M. Tsukada, unpublished data). Traces of *Plantago* pollen are evident throughout most of the core but the highest concentration is during the past 2500 years (upper 5 meters). This may also correlate with the heaviest disturbance from humans in the Huleh Valley. *Plantago* is known to thrive in areas of human disturbance. Possibly a more recent factor, e.g. agriculture, has caused its decline along with *L. pratensis*, in the Huleh Valley. This most recent period of the core is considered to be a park-like forest of oak-olive-pistacio association (Tsukada, unpublished data). Most of the present-day Huleh Valley is devoid of such an association due to extensive human development and agriculture. It is approximately this type of association that exists today in the surroundings of the Hurshat Tal Park where *L. pratensis* has been recently found on *Plantago lanceolata* L.. Therefore, we can assume that at the time of the fossil the area was somewhat similar to the modern Hurshat Tal area probably with more olive and pistachia and less disturbance from humans.

CONCLUSIONS

The use of a new method of identifying genera of flea beetles with the internal sclerotized metafemoral apodeme, together with measurements of size and shape, has permitted the determination of a subfossil from the former Huleh Lake region. This fossil hind femur is of *Longitarsus pratensis* which is a *Plantago*-feeding flea beetle. It was recovered from the upper level of a 54 meter core from the Huleh revealing the presence of *Plantago* in the park-like forest of oak-olive-pistachio association of that time (600-800 YBP). This correlates with the peak for *Plantago* in the pollen diagram of the core. The region of the core then was apparently similar to such a vegetational association existing today in the Upper Galilee of Israel. Because alticines are very widespread, living in a variety of habitats, and each genus restricted to a few plant families; they may also prove to be useful paleoecological indicators, e.g. Morgan, 1973. Although this subfossil is quite recent and demonstrates no major environmental changes, it does indicate some smaller ecological changes. It also presents an example of the usefulness of employing rather remote morphological characters for determination of fragmented insects as paleoecological indicators.

ACKNOWLEDGEMENTS

Special gratitude is due to Prof. G.E. Hutchinson (Department of Biology, Yale University) who provided the fossil insect fragments from his Huleh Lake core as well as encouragement, some financial aid, and a review of the manuscript. The figures were drawn by Ms. Debbie Townsend while working in the Entomological Section of the Peabody Museum at Yale University.

REFERENCES

Ashworth, A.C., L. Clayton and W.B. Bickley. 1972. The Mosbeck Site: a paleoenvironmental interpretation of the Late Quaternary history of Lake Agassiz based on fossil insect and mollusk remains. *Quatern.* Res. 2(2): 176-188.

Barth, R. 1954. O Aparelho Saltatorio do Halticineo *Homophoeta sexnotata* Har. (Coleoptera). *Mem. Inst. Oswaldo Cruz.* 52(2): 365-376.

Coope, G.R. The value of Quaternary insect faunas in the interpretation of ancient ecology and climate. *In:* Quaternary Paleoecology. Cushing and H.E. Wright, Jr., Eds. pp. 359-380. New Haven. Yale University Press. 1967.

Coope, G.R., A. Morgan and P. Osborne. 1971. Fossil Coleoptera as indicators of climatic fluctuations during the last glaciation in Britain. *Paleogeography, Paleoclimatology, Paleoecology.* 10(1971): 87-101.

Cowgill, U.M. 1969. The waters of Merom: A study of Lake Huleh. I. Introduction and general stratigraphy of a 54 m. core. *Arch. Hydrobiol.* 66: 249-272.

Cowgill, U.M. 1971. The waters of Merom: A study of Lake Huleh. II. The minerology of a 54 m. core. *Arch. Hydrobiol.* 71: 421-474.

Furth, D.G. 1975. Israel, a great biogeographic crossroads. *Discovery (Peabody Museum).* 11 (1): 2-13.

Furth, D.G. 1977. The Huleh and its lost acquatic leaf beetle. *Atala.* 4(1-2): 4-9.

Hutchinson, G.E. and U.M. Cowgill. 1973. The waters of Merom: A study of Lake Huleh. III. The major chemical constituents of a 54 m. core. *Arch. Hydrobiol.* 72: 145-185.

Matthews, J.V. Jr. 1977. Tertiary Coleoptera fossils from the North American Arctic. *Coleopterists Bull.* 31(4): 297-308.

Olhorst, S. and G.E. Hutchinson. 1977. The waters of Merom: A Study of Lake Huleh. V. Temporal changes in the molluscan fauna. *Arch. Hydrobiol.* 80: 1-19.

Olhorst, S., A. Shmida and G.E. Hutchinson. (in press). The waters of Merom. A study of Lake Huleh. VI. Fossil seeds from Lake Huleh. *Arch. Hydobiol.*

Racek, A.A. 1974. The waters of Merom. A study of Lake Huleh. IV. Spicular remains of fresh water sponges. *Arch. Hydrobiol.* 74: 137-158.

Sahlberg, J. 1913. Coleoptera mediterranea orientalia. *Öfversigt af Finska Vetenskaps-Societetens Forhandlingar* 15: 1-2, 250-258.