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Insects near Eocene Lakes of the Interior

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Standing on the shore of a modern lake one sees many insects flying, floating, or being blown away from the shore. The same must have been true on the shores of the numerous lakes that existed during the Eocene (about fifty million years ago) in the Interior of British Columbia and Washington. The rocks that formed from sediments of the ancient lake floor have yielded many fossil insects. Since at least the beginning of the Paleogene Era, the numbers of insect species and of individuals have far exceeded those of any other group of land-dwelling animals. Fossil insects are so numerous and so diverse, and the number of insect paleontologists so small, that only a tiny fraction of the story has been deciphered. The little we do know suggests that insect fossils have much to tell us – about changes in the composition of insect faunas over time, about the environments in which the insects lived and were buried, about the evolution of interdependence of insects and plants, and about rates of change within and among species.

Insect Diversity

As with many fossil fishes and plants, Eocene fossil insects have been studied for more than a century. Many of the pioneer geologists who collected Eocene fishes and plants also sent fossil insects to museums and to experts for study. As a result, early studies on fossil insects of British Columbia were published by Samuel Scudder and Anton Handlirsch. As well, geologist Tony Rice described fossil insects, including March flies (Bibionidae) and sawflies (Tenthredinidae). Paleontologists in the United States, particularly Standley Lewis and Wesley Wehr, have studied insects in closely related fossil beds near Republic, Washington (Lewis 1992; Wehr in press). My own research on BC fossil insects, a spin-off of my fish studies, has focused on their usefulness as indicators of past environments (Wilson 1988a).

These studies combine to show that Eocene insects were very similar to those of today, although probably not so similar that they belonged to the same species. Many kinds of Eocene insects are related to types that are rare or missing in the modern BC fauna, either because they became extinct throughout North America or because they are adapted to climates much warmer than those now found in British Columbia. A few rare examples of spiders have also been discovered in Eocene deposits of British Columbia and Washington.

Many of the most primitive living orders of insects are represented among the fossils; these include mayflies (Ephemeroptera), dragonflies (Odonata), cockroaches (Blattodea), grasshoppers (Orthoptera), and lacewings (Neuroptera). At least one group of primitive termites (Isoptera), now extinct in North America, has been found. Some of the fossil grasshoppers and other insects were much larger than their living relatives in British Columbia (Figure 18.1), suggesting that warmer climates prevailed then. A large proportion of the insect fossils are Hemiptera (bugs), including water striders (Gerridae), froghoppers or spittlebugs (Cercopoidea), aphids (Aphididae), and even stink bugs (Pentatomidae). Many of these were also large (Figure 18.2). As might be expected for a group adapted to live on the water surface, water striders are extremely common at some fossil sites (Figure 18.2E).

Fossils of adult caddisflies (Trichoptera) and alderflies (Megaloptera) are rare, but the cases built by young water-dwelling caddisflies are sometimes very common. Butterflies and moths are extremely rare, as yet represented by only a few specimens, which include a measuring-worm moth (Geometridae) recently found near Republic.

As in the modern fauna, the fly order is well represented both in quantity and in variety. Surprisingly, the family represented by more fossil specimens than any other is the March fly family (Bibionidae), which contributes more than half the specimens in many collections of Eocene insects of the Interior (Figure 18.3). Modern March flies are so named because their adults emerge in large numbers in the early spring. The family is well represented as fossils (Figure 18.3) but today is more characteristic of tropical regions. Other fossil flies include the crane flies (Tipulidae), fungus gnats (Mycetophilidae), wood gnats (Anisopodidae), and flower flies (Syrphidae). The fossil flower fly even has a striped abdomen like many of its modern relatives.

The wasps and bees (Hymenoptera) are well represented by primitive families, including sawflies (Tenthredinoidea) (Figure 18.1E) and parasitic wasps (Ichneumonidae and Braconidae) (Figure 18.1F). Among the groups usually considered more advanced are rarer examples of ants (Formicidae), paper wasps (Vespidae), and leaf-cutter bees (Megachilidae).

The beetle order (Coleoptera) is today one of the most diverse groups of organisms, but many Eocene fossil beds are without beetles (Wilson 1982). This unexpected finding must result from the particular environments

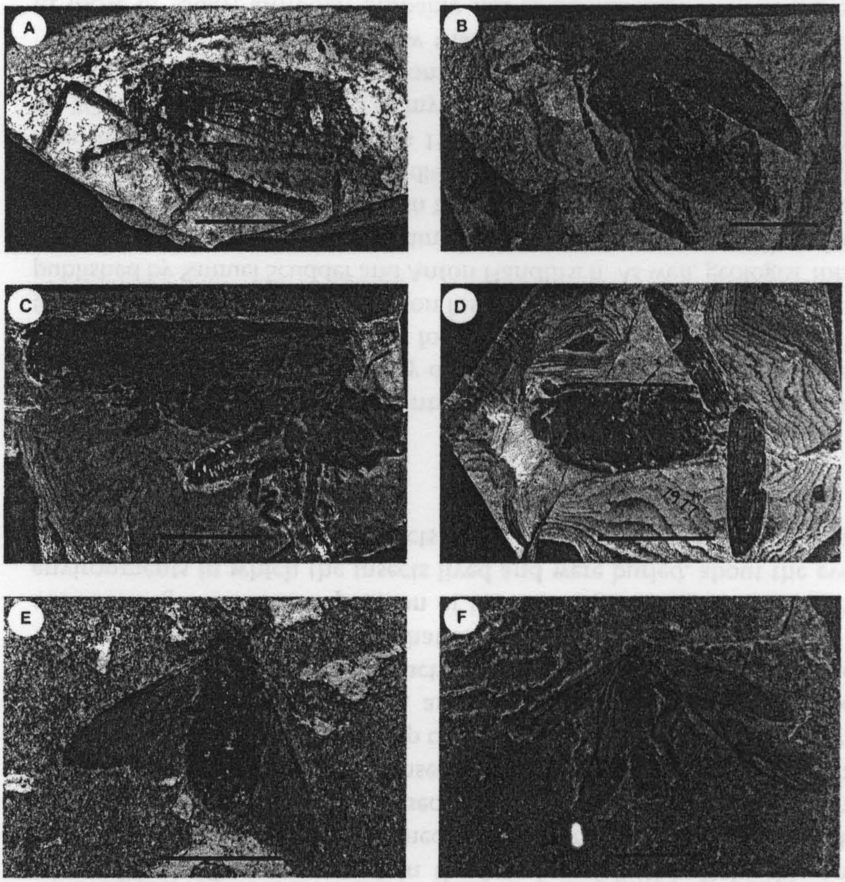

Figure 18.1 **Eocene insects of British Columbia.** (A) and (C) Grasshoppers (Orthoptera) from the Horsefly and Princeton areas. (B) and (D) Beetles (Coleoptera) from the Quilchena and Princeton areas. (E) Sawfly (Tenthredinoidea) from the Horsefly area. (F) Parasitic wasp (Ichneumonidae) from the Horsefly area. Scale bar lengths: (A) 20 mm; (B), (E), and (F), 10 mm; (C) and (D), 15 mm
Source: Fossil Insect Collections, University of Alberta

represented by these deposits, for beetles are an ancient group and are extremely common at fossil sites elsewhere. Where they do occur in the Eocene of British Columbia, the examples reported are of ground beetles (Carabidae), click beetles (Elateridae), stag beetles (Lucanidae), scarab beetles (Scarabaeidae), leaf beetles (Chrysomelidae), weevils (Curculionidae), and round-headed boring beetles (Cerambycidae). Some of the fossil beetles are surprisingly large (Figure 18.1B).

Overall, fossil deposits of Eocene age from British Columbia seem to contain greater numbers of insect species in certain groups and fewer in

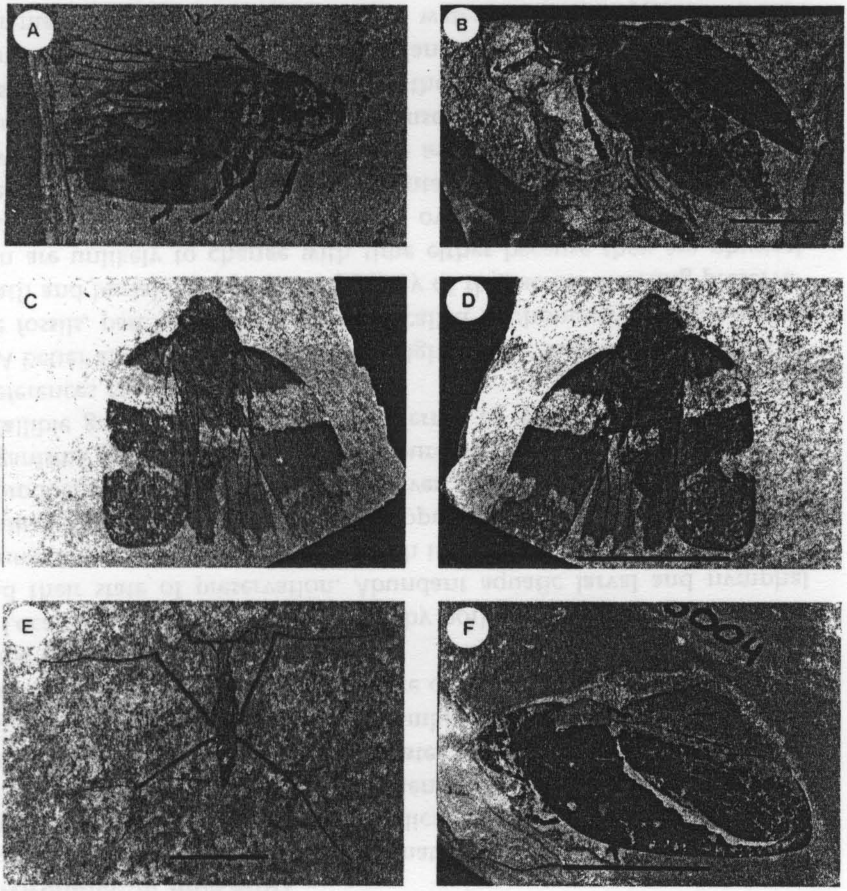

Figure 18.2 **Eocene insects of the order Hemiptera from British Columbia.**
(A) to (D) and (F) Three examples of froghoppers (Cercopoidea), in part and counterpart, from the Horsefly and Princeton areas. (E) water strider (Gerridae) from the Smithers area. Scale bar lengths: (A-F), 10 mm
Source: Fossil Insect Collections, University of Alberta

others than do comparable modern environments. This disparity might be explained by a difference in the factors affecting the preservation of fossils or by a consistent difference in the environments being sampled. When we examine apparently similar fossil deposits of Paleocene, Eocene, Oligocene, and younger ages, however, we find what appears to be a consistent trend. Basically, the younger deposits and modern faunas contain much larger numbers of advanced groups of flies, wasps, and butterflies than do the older fossil deposits. These differences were recognized a century ago by Scudder and elaborated on half a century ago by Charles Brues, who tallied fossils of various groups from fossil localities

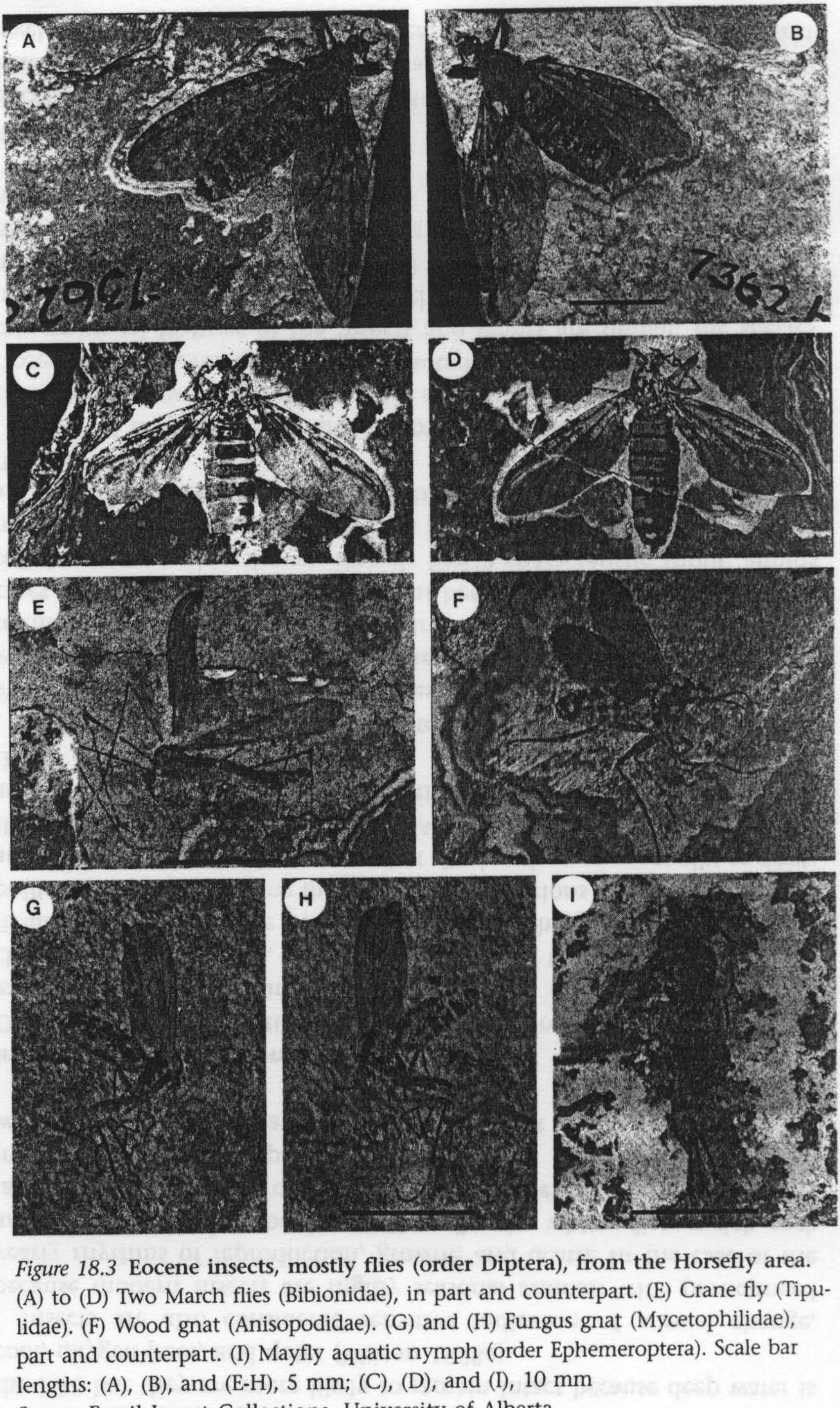

Figure 18.3 **Eocene insects, mostly flies (order Diptera), from the Horsefly area.** (A) to (D) Two March flies (Bibionidae), in part and counterpart. (E) Crane fly (Tipulidae). (F) Wood gnat (Anisopodidae). (G) and (H) Fungus gnat (Mycetophilidae), part and counterpart. (I) Mayfly aquatic nymph (order Ephemeroptera). Scale bar lengths: (A), (B), and (E-H), 5 mm; (C), (D), and (I), 10 mm

Source: Fossil Insect Collections, University of Alberta

Eocene species and genera are now extinct – or at least have no living North American representatives – as is the case for the fossil termites whose relatives survive today only in Australia. Even so, only minor changes distinguish the living from the fossil species.

How minor were some of these changes? A recent study of fossil and living water striders of British Columbia (Anderson et al. 1993) found that the Eocene species are nearly indistinguishable from their living relatives, and that this group was much older than biologists had previously estimated through study of genetic differences. Nevertheless, the fossils are exceptionally well preserved, and it is often possible to distinguish sexes and even to measure the lengths of individual segments of the antennae. A fossil of a male water strider from the Smithers area, for example, appears identical at first glance to a male of a species living today in British Columbia; but, unexpectedly, it has a terminal antenna segment longer than that of any of its living relatives. No other feature appears to differ, even slightly. Whether this small change in the antenna had any significance for the survival of these water striders is not known.

It has long been realized that insects are exceptionally diverse and abundant. Some entomologists have argued that, to achieve such diversity, insects must have evolved and produced new species very rapidly. Yet many insect groups possess great antiquity (Wilson 1983) and have experienced little morphological and genetic change (Anderson et al. 1993). These findings suggest that insect species are long-lived, lasting millions of years, and that even genetic molecules change slowly in some groups of insects. It seems a paradox that such a very diverse group can evolve so very slowly. This important lesson is one to be learned from the fossil insects of British Columbia.

Insects are phenomenally varied, numerous, and sensitive indicators of past environments and of the interdependence of animals and plants. Paradoxically, they appear to have evolved slowly, yet they dominate the terrestrial environment. Although they are among the most easily collected and intellectually rewarding of fossils, they are among the least studied. Imagine the interesting tales that BC fossil insects could tell if they received their fair share of attention.

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