Insect Pollinators Before Angiosperm Domination

GEOL 204 The Fossil Record

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Overview

- Gymnosperms (Non Flowering Plants)
  - Likely originated during the middle devonian period, about 390 million years ago
    - Angiosperms, flowering plants, first appeared in the lower cretaceous, only about 125 million years ago
    - Gymnosperms were the first vascular plants, meaning that they had tissue that allowed them to conduct water and minerals throughout the plant
    - Gymnosperms were also among the first plants to inhabit land
  - Gymnosperms are still around today, and are represented by 4 clades: Coniferophyta, Cycadophyta, Ginkgophyta, and Gnetophyta.
  - Gymnosperms carry exposed seeds that sit on leaf like structures called brasts, where the seeds of angiosperms are generally encased by an ovary.
  - Gymnosperms secreted nectar to reward pollinators (6)

Neuroptera (lacewings)

- Neuroptera most likely pollinated and fed using a long proboscid (9)
  - Three major pollination modes reported from deposits that were 165 to 105 million years old, including neuroptera
    - The long proboscid likely took liquid drops from gymnosperms
    - The long proboscid was used for siphonate fluid feeding, highly adapted for the uptake of pollen and nectar
    - Was found in Karatau, Russia from 155 million years ago and Daohugou, China from 165 million years ago
  - Further detail is in the fossil record:
    - Fed on the Classopollis cf. annulatus pollen and other undetermined bisaccate

Modern day neuropteran (4)

Coleoptera (beetles)

- Pollination mode of beetles: chewing (9)
  - Evidence:
    - *Darwinylus marcosi* (false blister beetle) found with 126 pollen grains in amber (9)
      - Patterns of the pollen suggest they were attached to the beetle before being swept by the resin (9)
      - Pollen grain structure suggests they are from a gymnosperm and entomophilous (pollinated by insects) (9)
    - *Cretoparacucujus cycadophilus* found with pollen grains from Cycadopites in amber from mid-Cretaceous of Myanmar (2)
      - Mandible with cavity known to contain pollen (2)
      - Maxilla with structures that could have been used to collect pollen and direct to mouth (2)
      - Pollen grains found in clumps- characteristic of entomophilous plant pollen (2)
- Beetles, including false blister beetles, transitioned to angiosperm host after transition from gymnosperm domination to angiosperm (9)

Reconstruction of *Darwinylus marcosi* with inferred location of pollen grains before being swept by resin (9).

Diptera (flies)

- *Exesipollenites*-like pollen was found on the abdomen of a fly of the family Zhanvsolvidae (8)
  - It had a long proboscid which was likely used to suck nectar from flowers of unknown plants (8)
  - The pollen was likely from an entomophilous cycad-like gymnosperm from about 250-70Ma (8)
- Zhangsolvid flies lived at least between 150 and 100Ma (8)
- Based on extant species with a long proboscis, it most likely hovered during flight (8)

Reconstruction of Zhangsolvid fly (8)

Mecoptera (scorpionflies)

- Pollination mode of scorpionflies
  - Scorpionflies have long proboscid used to feed on liquid polintion drops from gymnosperms (10).
  - Scorpionflies siphoned pollen from gymnosperm reproductive systems. (10)
  - Engaged in mutualism with gymnosperms (10)
    - Scorpionflies got the pollen and in turn they pollinated plants (10)
    - Scorpionflies may have also fed on other bugs attracted to gymnosperms (10)

Aneuretopsychidae from Late Cretaceous Burmese amber (10)

Thysanoptera (thrips)

- Pollen grains found on four specimens in amber (7)
  - Species were covered in cycadopite pollen grains
- Pollen found on ring setae, a specialized structure to collect pollen grains on female thrips (7)
  - Suggests a method of parental food provisioning for larvae.
- Provides direct evidence of gymnosperm pollination 110-105 million years ago, perhaps earlier (7)

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