
AQUATIC INSECTS AS INHALANT ALLERGENS: A
REVIEW OF AMERICAN LITERATURE^{1, 2}

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ABSTRACT

This article reviews American literature concerning the matter of certain aquatic insects as causes of allergic distress. The effects of bites and stings are not included. Mayflies (Ephemeroptera) were cited as a cause of hay fever as early as 1913. Inhalation of body fragments of mayflies is believed to be the causative agent. Similar medical histories are associated with the caddisflies (Trichoptera). The incidence of sensitivity to these insects is sufficiently large to consider this problem to be of general medical interest. Some evidence indicates that persons continually exposed to these insects could develop sensitivities to them. Allergists are now studying the biochemical and immunological aspects of insect allergy. A selected list of references is included with the article.

A large emergence of mayflies occurred during one of my visits to western Lake Erie some years ago. This emergence made me recognize that I was allergic to them. Because many persons working with aquatic insects are not aware of this aspect of entomology, it was suggested that I make this report and appraise aquatic organisms as causes of allergic distress.

The role played by insects in environmental medicine penetrates into ancient

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history, but early references were mainly concerned with bites and stings. This aspect is not included in the present discussion.

Early references to insects as inhalant allergens dealt with them as matters of medical curiosity of only local significance or as specific occupational hazards. More serious concern was shown this subject when it was realized that allergy to insects might be the answer to the enigma of allergic patients in many cases not responding to usual testing and treatment.

Ephemeroptera (mayflies) were first cited as a cause of allergic distress by Wilson in 1913. A man from Detroit complained of severe attacks of hay fever whenever he drove through swarms of mayflies. It required approximately two days for him to recover from his attacks. Wilson made simple saline extracts of the mayfly in confirmatory tests to prove that the mayfly was the allergen. Similar cases were reported from Buffalo, New York, during the same summer.

Mayflies are also known to be an allergic excitant of asthma (Figley, 1929; MacDermot, 1934). In 1938, Parlato made clinical tests on over 500 seasonal allergy patients in Buffalo, New York; 3.2 per cent of them exhibited a positive skin test to mayfly extract. Figley (1940) cites that many workers in power plants along the Mississippi River frequently become sensitized to riverflies and develop rhinitis or asthma.

Inhalation of cast skin and body fragments of mayflies was thought to be the cause. In most instances, relief was obtained by desensitization or by removal of the patient from mayfly-infested areas.

Trichoptera (caddisflies) have a similar history. In 1929, Parlato made the first report of a case of allergic disease caused by the caddisfly. In this instance, the patient, who was from Buffalo, New York, exhibited seasonal symptoms of hay fever and asthma, with irregular occurrences during winter months. Her condition had been getting progressively worse. She tested negative to all of the known allergens and she did not fit the pattern of seasonal allergy cases. The caddisfly later became suspect and a variety of clinical tests confirmed a positive reaction to this insect. The winter symptoms were induced when she swept the attic and disturbed bodies of Trichoptera. The patient was successfully desensitized. Parlato considered the hairs and scaly epithelium of the insect to be the causative agent.

In a series of subsequent studies (Parlato, 1930; 1934; Parlato et al., 1934), the abundance of caddisflies in the region of the Great Lakes was noted, and Parlato emphasized that this insect might be a more general menace to health than previously recognized. He suggested that investigation of this matter might indicate specific sensitivity of patients of unknown etiology. By means of several clinical tests, Parlato examined 192 patients, of whom 7.3 per cent exhibited a positive response to Trichoptera, an incidence sufficiently high for him to declare that this insect was not a rare cause of allergy. Emanations of Trichoptera may be transported several miles inland from lakes, but the greatest concentrations are within a mile from shore.

Osgood (1957a, b) continued to study the caddisfly in Buffalo. His first article was devoted mainly to the description and ecology of the insect. Studies by Munroe (1951) and Peterson (1952) indicated that the Narrows between Buffalo and Port Erie were major breeding grounds for the Trichoptera, but that they were much more abundant along the rocky ledges on the Canadian side of the Niagara River. Twenty-three species of Trichoptera were identified in this area of the Niagara River. About 75 per cent of the Trichoptera found were *Hydropsyche bifida*, and another 20 per cent were *Hydropsyche placoda*, *Oecetis avara*, *Macronema zebrata*, and *Neureclipsis crepuscularis*. Swarms as dense as five insects per cubic foot were found within a half mile of shore. Swarming began when the water temperature reached 60° F. The season extended from mid-June to September.

A normal person is unaffected by even a heavy exposure. Sensitive persons can get relief about five miles from shore, but those who have been exposed for several years suffer increasingly severe symptoms.

Osgood tested 623 allergic patients for sensitivity to the caddisfly. Only 12 per cent showed a strong reaction and 38 per cent were negative. He found sensitivity in 60 per cent of the patients living in the lowland areas of heavy exposure to the insect, 35 per cent of those living in areas of moderate exposure, and only 22 per cent of those living in areas of little or no exposure. There was some evidence that non-affected persons who were continually subjected to heavy exposure could eventually develop sensitivity to Trichoptera.

Most patients responded well to treatment, but there were some failures. An inspector on the Peace Bridge, extremely sensitive to Trichoptera, did not respond to treatment and had to be transferred to an inland post.

Most allergic patients are not sensitive to Trichoptera alone. Of 200 patients positive to Trichoptera, 43 per cent showed a stronger reaction to caddisflies than to mayflies; 17 per cent were more positive to mayflies. Eight per cent were negative to mayflies (Osgood, 1957a, b).

The dipterous family Tendipedidae (= Chironomidae) has also been reported to incite allergic conditions. An employee of a hydroelectric plant in Alabama developed asthma evidently induced by emergences of *Tanytarsus* (Weil, 1940). Widespread incidence of asthma and other allergic symptoms that have developed in Khartoum and other cities on the Blue Nile River in Africa have been attributed to the Tendipedidae (Rzoska, 1964). *Tanytarsus lewisi* is the dominant species in this area. The body fat of these midges is similar to that of algae, and the polyethenoid fatty acids are those normally associated with fish (allergy to fish is not uncommon). The imagines of *Tanytarsus* (= *Calopsectra* Kieffer) are distinguished by having hairs on the wings (Malloch, 1915). These hairs may be the excitant.

The fact that certain aquatic insects are responsible for the onset of hay fever, coryza, rhinitis, and asthma is well documented. The list of invertebrates that are inhalant allergens is growing. Bronchial asthma has reportedly been induced by dried *Daphnia* (Way, 1940) and sewage flies, *Psychoda* (Ordman, 1946).

Now that a case has been made against aquatic organisms, allergists have shifted their attention to biochemical and immunological aspects of the problem.

Patients with an allergic history exhibited a significantly higher incidence and more severe reactions to skin tests with insect extracts than did non-allergic individuals. Pollen-sensitive patients were significantly more sensitive to insects than were the nonseasonal allergic patients (Wiseman et al., 1959).

Most persons sensitive to one insect have similar sensitivity to others. Reactions to the Lepidoptera, Ephemeroptera, and Trichoptera were similar, and common antigens were suspected for all orders. The degree of reaction differed for different taxa, and it was found that the reactions were more similar within an order of insects than between orders. This led the medical researchers to conclude, from their serological studies, that the arrangements made by insect taxonomists were basically sound. Many of the references consulted, especially the earlier ones, indicated deficient knowledge of elementary entomology.

Several antigens were evident in total insect extract, and two excitants are possibly present in the integument.

The American Academy of Allergy has an "Insect Allergen Subcommittee," which is accumulating clinical data on this subject and now works in close consultation with entomologists. The role of aquatic organisms with respect to this aspect of human health may assume a much broader significance in the future.

Appended is a selected list of references that deal with the role played by aquatic organisms in causing allergic distress.

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