G66 Caddisfly Cases Assist Homicide Case: Determining a Postmortem Submersion Interval (PMSI) Using Aquatic Insects

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The goal of this presentation is to discuss a particular case study that exemplifies the importance of understanding aquatic insect biology to help determine a postmortem submersion interval (PMSI) in streams, rivers, and possibly lakes. This study demonstrates how certain aquatic insects, e.g., caddisflies (Order: Trichoptera, Family: Limnephilidae) can be useful in estimating the time period from a body is submerged to the point of discovery. The attendee will learn that some aspects of aquatic entomology can be useful in criminal investigations by learning how to incorporate life history aspects of aquatic insect biology to estimate a PMSI.

This presentation will impact the forensic community and/or humanity by demonstrating that there are aspects of aquatic entomology valuable to forensic investigations involving bodies recovered from aquatic systems. To date, very little research exists on the use of aquatic organisms to estimate a postmortem submersion interval; this particular case illustrates how aquatic insect evidence can augment traditional techniques used in criminal investigations to develop a PMSI time line.

The determination of a postmortem interval using entomological evidence collected from terrestrial crime scenes has been well documented. A review of the literature found that approximately 85% of studies pertained to terrestrial organisms, while only 15% pertained to aquatic organisms. This dichotomy can be explained simply because terrestrial insects have evolved to feed on carrion while aquatic insects have not, Therefore, because the biology of some terrestrial insects is intimately tied to decomposing animal flesh, where aquatic insect biology does not, this biological difference has facilitated the use of terrestrial insects in criminal investigations. Consequently, many times aquatic insect evidence is ignored from crime scenes in aqueous environments. Since remains are often found in aquatic environments, it is important that forensic scientists and law enforcement personnel visiting such crime scenes have an increased knowledge of the aquatic organisms that could potentially colonize human remains.

Although few indicators of time since death for remains found in aquatic ecosystems are comparable in precision to the insect indicators used in terrestrial cases, there are observations that can be useful in suggesting or ruling out an approximate PMSI. For example, the time intervals needed for certain growth phases of aquatic insects such as caddisflies that may attach themselves to the remains can be used to estimate a minimum PMSI. Approximately eight of the 13 orders of insects containing species with aquatic or semi-aquatic stages are likely to be associated with carrion or remains in aquatic habitats. The evolution of a vast array of physiological and behavioral adaptations in aquatic insects enables these organisms to inhabit virtually all bodies of water.

Portions of a body from an adult male were discovered in a south central Michigan stream. The body was dismembered and portions were recovered from plastic bags floating in the stream. Insects specimens collected from the plastic bags containing body parts consisted of one fly larva (Diptera) belonging to the family Muscidae, and caddisfly larvae (Trichoptera) belong to two families, the Limnephilidae or case-makers and the Hydropsychidae, net spinners. Because of case material type, size of mineral pieces used in the case, and the size of the stream from where they were collected, larvae belonging to the family Limnephilidae were separated into two different species, as well as placed in specific larval instars (or larval stage of development) which helped to age them. Based on the similarities of the behavior, life histories and occurrence of these two species throughout the year, two caddisfly species belonging to the genus *Pycnopsyche* were present, mainly the last developmental larval stage of *Pycnopsyche lepida* and *Pycnopsyche guttifer* were identified. Unique case-building behaviors of these Limnephilid caddisflies found on the remains were used to elucidate a PMSI range consistent with the disappearance of the victim. It is important for forensic investigators to understand that although some precision is lost in estimating a PMSI with aquatic insects, these organisms should not be ignored in gathering evidence from aquatic crime scenes, that in fact, they can provide valuable details in estimating a PMSI.

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