G13 Minimal Submersion Period Estimation Using Freshwater Benthic Fauna and Wagner's Parsimony Method (WPM): Tools for Forensic Investigations in Different Lotic and Lentic Environments

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After attending this presentation, attendees will learn information about a new method to estimate a minimal submersion period for a corpse found in freshwater.

This presentation will impact the forensic science community by possibly providing a PMI estimate in freshwater by studying fauna using Wagner's parsimony method.

The forensic investigations are generally very difficult when a body is discovered immersed for an undetermined period of time in freshwater. Due to long periods of immersion and a high level of putrefaction, the estimation of the time since death is problematic. Classical forensic entomology is based on existing links between necrophagous insects and the state of decomposition, in order of appearance of necrophagous insects on the cadaver. This science does not allow a pertinent evaluation of the time since death for a crime scene technician. It is indeed impossible to reach any conclusions based on the underwater colonization process once the cadaver has resurfaced. The purpose of this work was to analyze from February 2001 to October 2002, the different cases of cadaver discoveries in order to isolate pertinent bioindicators. The database consists of a medicolegal set, ecological, and judicial observations recorded on 30 freshwater. This study gathered the following data: freshwater loci (lotic or lentic), geographical location, first elements on discoveries, season, and the postmortem interval (PMI) recorded by pathologist during autopsy. In all cases, the PMI was estimated between half a day and three years and only involved adult victims.

Two types of mathematical methods can offer an ecological data processing: phenetic's methods and parsimony method. Phenetic' methods, based on the total inter-sites similitude, give calculations of distances and links between sites.

Because of the risk of confusion due to the infinite mathematical distances, number, and computational tools, phenetic' methods seem inappropriate for this type of investigations. So, Wagner parsimony method which does not authorize scenarizations but does allow a strict objectivity between diagram and data matrix was chosen.

Forensic application of WPM allows analyzing presence/absence of aquatic and terrestrial invertebrates on different crime scenes according to the method described and respectively applied by Masselot et al. to freshwater biomonitoring and Coiffard et al. to taxon lists of fossil plant assemblages of the Cretaceous. Leaves of the trees were considered as crime scene ''localities.'' There were gathered according to their environmental or taphonomic states of characters (synapocoenoses sensu Nel et al.). Attributes are independent sets of information (e.g., "victims" parameters).

For corpses found after a one to three weeks period of partial submersion (floating) in a lotic or lentic freshwater environment, attributes required for colonization were the accessibility to the surface, the presence of clothing, a high decomposition level, and the presence of algae and mud. In the 30 cases studied (PMI from one day to three years), invertebrates were systematically absent on fresh (low PMI of under two to three days) and on very decomposed cadavers (skeletal remains). Evidence of a colonization process had disappeared on unclothed cadaver or when postmortem changes occurred. In the laboratory, correlation was explained between the development rate reached by each arthropod specimen and the stage of decomposition recorded at the autopsy. Study of the parsimonious biocenogram demonstrated different gradients associated with increasing postmortem delays:

- Specimens of the order of Gasteropoda were the first colonizers on a cadaver submersed for one week or more. Gasteropoda sampling is particularly congruent with a lotic environment, partial submergence, and presence of clothing. Fist gastropods were collected from carcases just after five days of immersion.
- Second contributors to cadaver coloniszation were immature forms of Diptera. They were mainly collected from the muddy clothing on the cadavers. At the same time, the presence of species of Diptera was found during Spring on submerged cadavers (PMSI from three weeks to two months). Totally submerged corpses were mainly attractive to aquatic species of Chironomidae or Simuliidae, and floating cadavers had a concomitant colonization of aerial Diptera and aquatic fauna.

With regard to the colonization by aerial Diptera, it appears wrong to use necrophagous insects alone for the estimation of PMI. In fact, the aquatic environment was able to defer oviposition (egg-laying), to reduce larval density on emergent parts of the corpse and to slow down the development rate of insects (influence of lower water temperatures and washing effect of the corpse).

A simple but effective sampling protocol to get a real solution to the problem of estimating the postmortem submersion interval (PMSI) of a cadaver found in lotic or lentic water was created.

Postmortem Submersion Interval, Freshwater Invertebrates, Wagner's Parsimony Method

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