

Forensic Archaeology Pollen

Forensic Palynology – pollen, spores
and other resistant micro-plant
remains = palynomorphs

Used to help solve legal issues – civil
or criminal

Used in a wide range of cases

Criminal cases

Homicide

Genocide

Rape

Assault and robbery

Hit and run

Arson

Terrorism

Drug dealing

Forgery

Counterfeiting

Illegal importation

Civil cases

Pollution

Illegal fishing

Geopreservation

Provide link between:

Suspect and scene of crime or discovery scene

Victim and scene of crime or discovery scene

Relate item at crime scene or discovery scene to suspect

Relate item at discovery scene to crime scene

Prove or disprove alibis

Determine travel history of items, e.g. drugs

etc.

Why use pollen and spores?

Pollen grain = male gametes (sex cells - sperm) of higher plants

Spores = sexual or asexual reproductive bodies of lower plants and plant allies, e.g. ferns, mosses, fungi, algae, liverworts and lichens

Useful because of the following:

1. Small size
2. Resistance to decay - mechanical, biological and chemical degradation, resulting in preservation in and on range of media
3. Abundance in environment
4. Distinct morphology allowing identification, within limits, to specific plant taxa

Locard's Exchange Principle:

Whenever two objects come together there is always a transfer of material

Each location has its own pollen assemblage (pollen profile or pollen fingerprint)

Each outdoor habitat has unique palynological assemblage and includes:

1. Palynomorphs from local plants and fungi
2. Pollen from plants recently flowered
3. Pollen blown in from external sources
4. Palynomorphs from plants/fungi previously present but no longer

Habitats likely to include micro-habitats

Every habitat where a suspect or vehicle could have picked up pollen needs a control sample taken

Pre-scene attendance

Need to establish that useful evidence can be obtained

What do the police want and can palynology help? Often only supporting evidence.

Linking suspect to location. Need to understand habitat of location and whether person could have spent time in similar habitats.

Need a pollen profile unique enough to be of use.

Pollen profile of a location will change so chances of obtaining good pollen comparator samples will decrease the longer the time since the crime occurred.

Scene attendance

Assessment of scene with Police Officers - approach and information.

Vegetation survey in and around site - likely pollen assemblage source.

Collection of samples for pollen or botanical analysis, e.g. soil, carpets

Scene evaluation to determine whether or not palynological analysis is worth pursuing and other locations visited.

Possible requirement to attempt to seek location of clandestine grave.

Possible visits to other locations to obtain control samples (similar treatment to main scene).

Possible mortuary and/or car pound to collect samples.

Contamination of samples

Potential for ambient air to contaminate samples, particularly spring and summer.

Collection of samples

Sterile containers, label, recording, etc.

Laboratory analysis

Sampling of exhibits, recording, etc.

Storage – fridge, frozen

Preparation of samples

Identification and counting

Minimum of 300 grains. May require more to identify rare types.

Spreadsheet

Data may be converted to percentages for compare relative frequencies.

Statistical analysis.

Analysis and interpretation

Don't over-emphasize presence of less common types when comparing samples from exhibits with control samples, e.g. honeysuckle. Commonly occurs in trace amounts. Need other key types in both assemblages.

Reporting and court appearance

Use tables and charts

Will be sent to opposing counsel.

May be requirement to visit alibi scene.

Opposing counsel

How samples collected?

Was scene visited by expert witness or detailed photographs and notes received?

Could suspect have previously visited scene legitimately?

Did suspect spend time in similar habitat? Pollen profile could be similar.

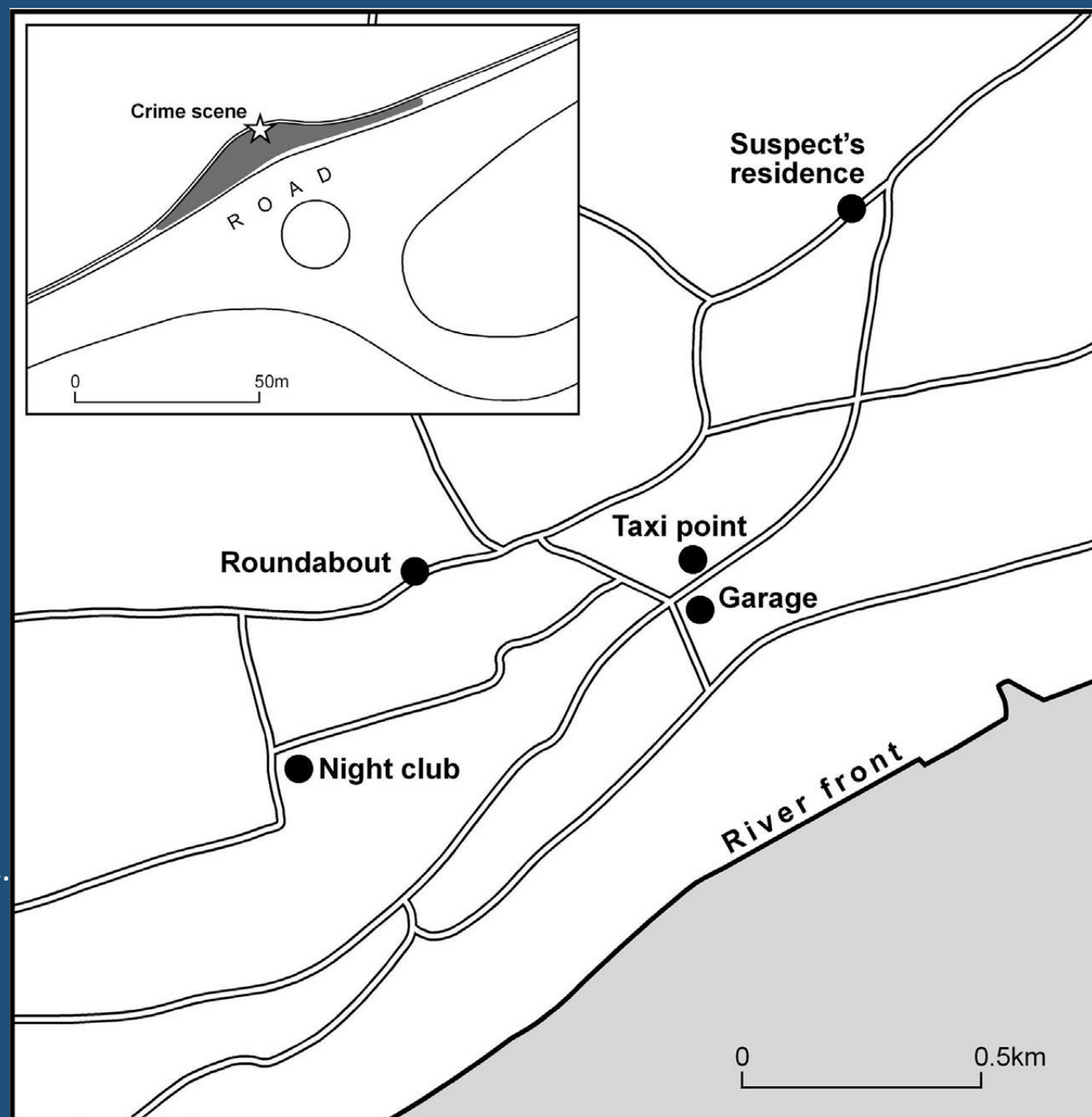
Have similar scenes been sampled or visited by palynologist?

Could samples have become contaminated? How collected?

Dundee Murder Case

Investigation by
Wiltshire *et al* 2015
Forensic Science
International 254,
231-242

Map of relevant locations.
Inset, map of crime scene.



Murder Case in Dundee

Body of murdered woman on periphery of planted roundabout Dundee.

Suspect - footwear yielded similar palynological (botanical and mycological) profile to that obtained from:

1. ground and vegetation at crime scene
2. victim's clothing

Palynomorphs at roundabout were from in situ vegetation and macerated woody mulch which had been deposited on ground surface

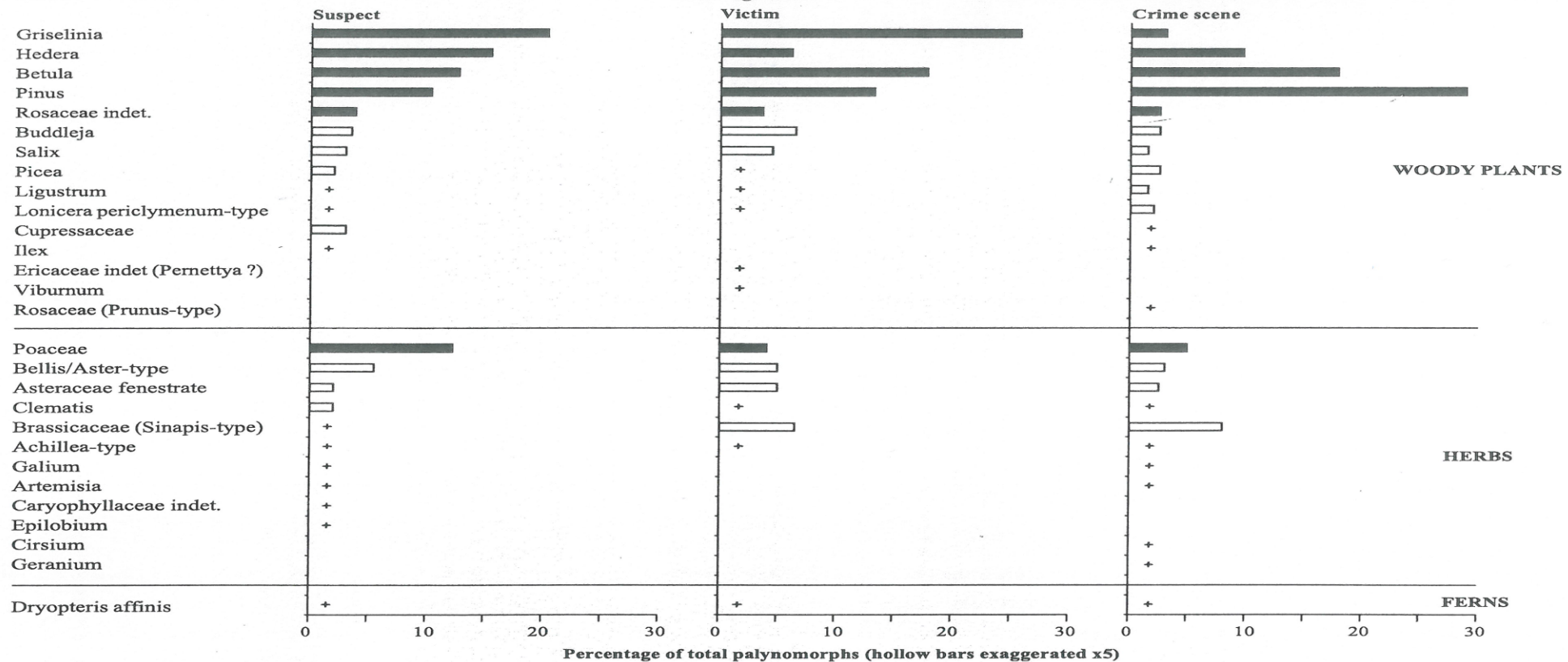
High level of resolution in results because of:

1. High degree of rarity of individual forensic markers
2. Complexity of the overall pollen profile
3. Application of pollen and mycological expertise

Note high percentage of *Griselinia* and *Buddleja* as well as *Hedera*, *Betula*, *Pinus* and *Rosaceae* indet. At crime scene

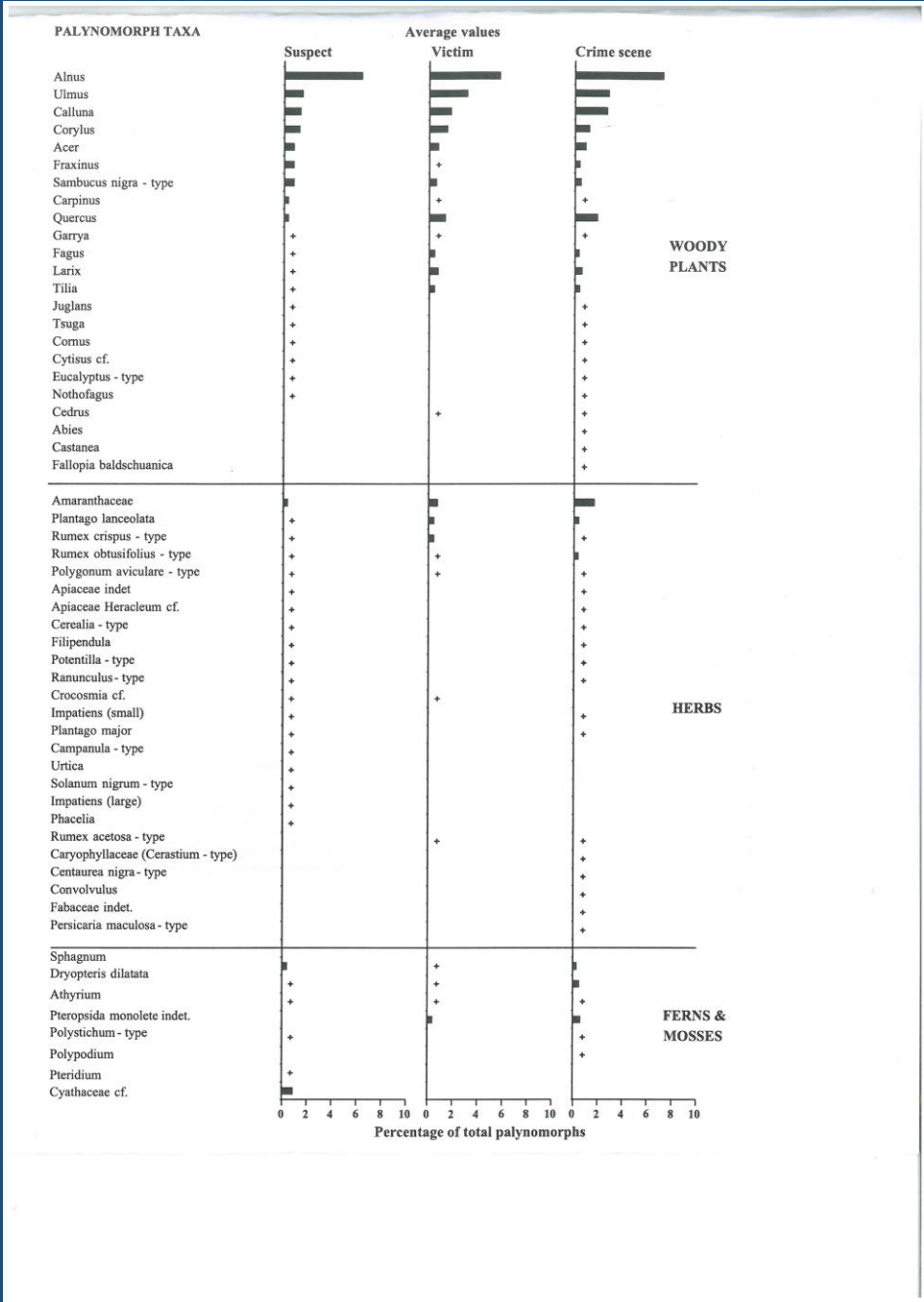
Woody mulch high values for *Alnus*, *Ulmus*, *Calluna*, *Corylus*, *Acer*

PALYNOMORPH TAXA



Proportions of palynomorph taxa found on victim, suspect and from the plants growing at the crime scene.

Proportions of palynomorph taxa found on victim, suspect and from the woody mulch at the crime scene.



Outcomes

Results enabled exhibits to be linked to crime scene

Suspect was convicted of murder

Interpretation of results led to conclusions:

1. Additional essential protocols for crime scene sampling
2. Need for advanced expertise in identification

Rape case from southern England

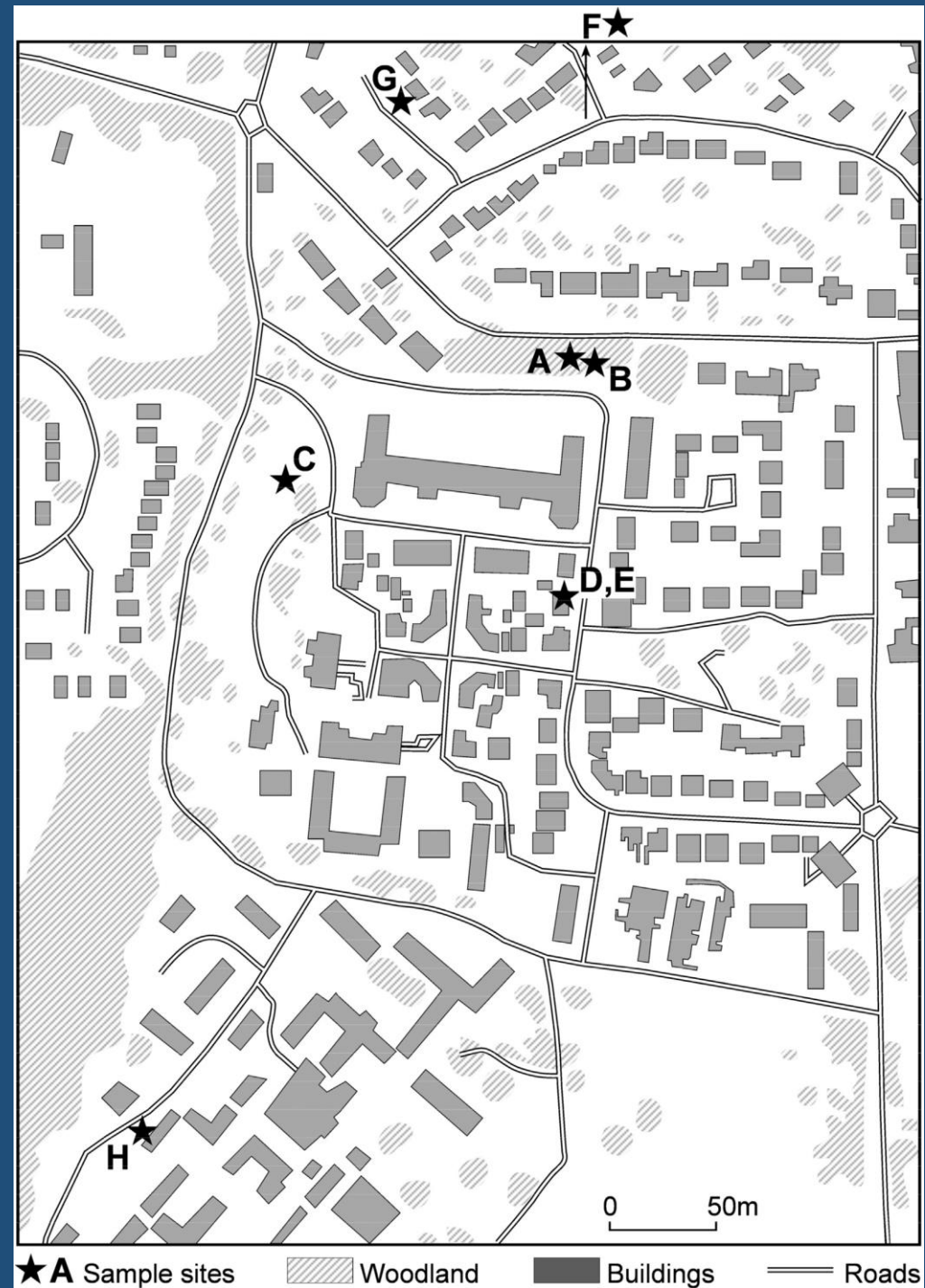
Use of palynological and mycological evidence from same forensic samples

Young woman claimed to have been raped in a wooded strip of land 120m from home

Suspect claimed they had had consensual sex on area of short turf 130m from alleged crime scene

A - Crime scene; B - path approaching crime scene; C - park; D - claimant's back garden; E - claimant's front and side garden; F - public open space in the town; G - site where defendant discarded his over-trousers; H - defendant's lodgings

P.E.J. Wiltshire, D.L. Hawksworth,
J.A. Webb, K.J. Edwards
2014 Forensic Science International
244, 186-195.

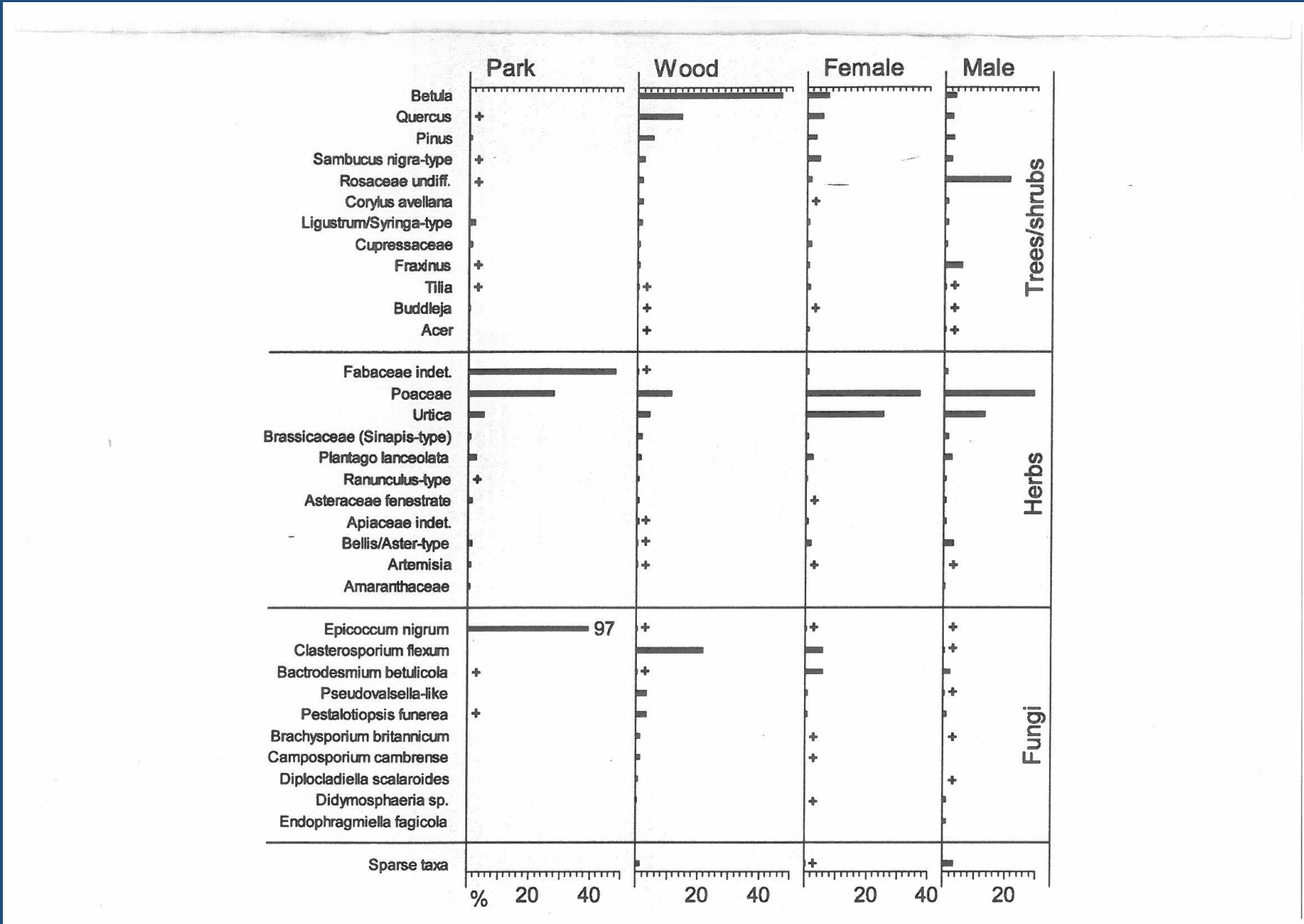


Comparator samples taken from:

1. Each place
2. Clothing and footwear of victim and suspect
3. All relevant places visited and lists of plant species made

Simplified
palynomorph plots of
sample profiles.
+= <0.5%

P.E.J. Wiltshire,
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Results

Palynological and mycological profiles from footwear and clothing closely resembled that of wooded area, not the park.

Good representation of *Betula*, *Quercus*, *Pinus*, *Sambucus nigra* type, *Rosaceae* undiff.

Poor representation of *Fabaceae*

Good representation of *Clasterosporium flexum*

Poor representation of *Epicoccum nigrum*

Profile of wooded site closely reflected its own vegetation

Faced with evidence, suspect confessed

Suspicious death case

A 'shaman' was accused of causing the death of a young man

The deceased had participated in ceremony involving drinking of ayahuasca to induce a psychotropic experience

Ayahuasca is infusion of:

1. *Banisteriopsis caapi* (ayahasca vine) – produces a monoamine oxidase inhibitor and
2. tropical plant(s), generally *Psychotria viridis* (chacrana) – produces dimethyltryptamine (DMT)

Monoamine oxidase inhibitor prevents DMT being broken down in gut, enabling its passage into bloodstream and across blood/brain barrier.

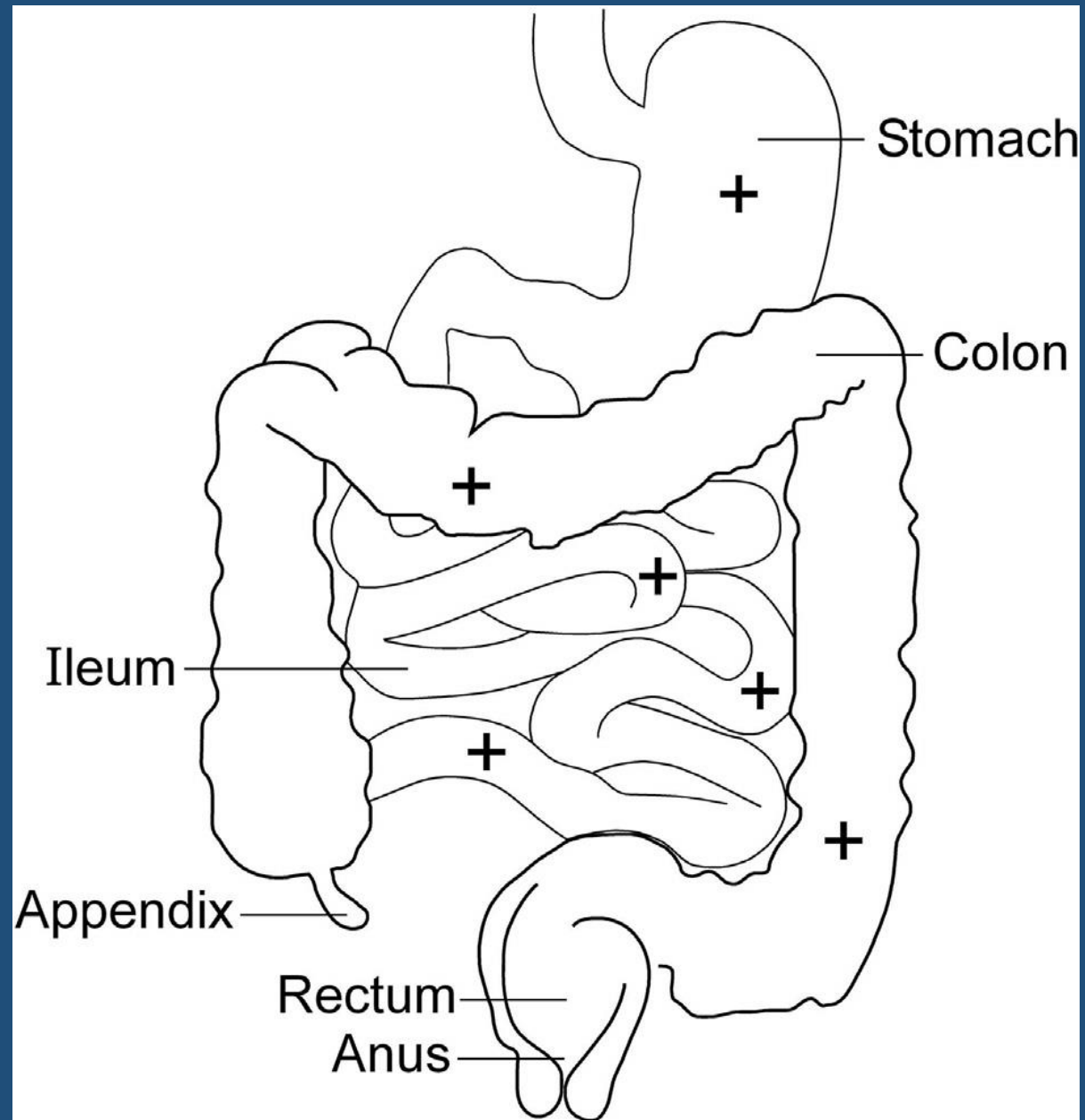
Toxicological tests demonstrated DMT in body

Deceased reported to be in habit of using *Psilocybe semilanceata* (liberty cap) - magic mushroom

Contains psilocybin which is hydrolysed in gut to psilocin - mimics a serotonin uptake inhibitor, and invokes psychotropic experiences

Schematic representation of the human gut.

+ = approximate sample locations



Samples taken from gut for microscopical examination of plant and fungal remains

Demonstrated that ileum and colon contained:

1. spores of *Psilocybe*
2. Pollen of *Cannabis sativa* and seeds of *Papaver e.g. somniferum* – both produce psychotropic substances

Containers from deceased's dwelling also produced abundant trace evidence of pertinent pollen and spores

Police had requested analysis for DMT but no screening for other psychotropic substances

Investigators surprised a mixture of hallucinogenic materials had been consumed

Charge modified from manslaughter to possession of 'Class A' drug as deceased had been consuming drugs not administered by the 'shaman'

Demonstrates need for caution in interpreting toxicological results where screening for unusual compounds has been limited

Where death involving drugs from plants or fungi is suspected then examination of samples from gut can be a rapid and effective method for assessing, in a temporal context, the presence of ingested materials not previously suspected.