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Forensic Entomology and the Order Coleoptera

Carrie Pratt
University of North Dakota

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### Introduction

Medico-legal forensic entomology is the study of insects to aid in determining time, place, manner, and cause of death\(^1\). Identification of the postmortem interval (PMI), or the time that has passed since a person has died, is arguably one of the most important pieces of information that forensic entomology can provide. The PMI can be found using either insect developmental rates or entomological succession, the arrival of different insects at a body at different time points. The largest group of insects, the beetles, is the order Coleoptera, which contains 25% of all animal species\(^2\). Members of this order are critical to the field of forensic entomology, predominantly necrophagous beetles that feed directly on the tissues of bodies, but also those that feed on the larvae of necrophagous insects. The family Silphidae, also known as carrion beetles, is an especially important group which employs both feeding strategies. Understanding both the order Coleoptera and the family Silphidae and how they relate to the field of forensic entomology is an important step in recognizing their importance and furthering research into necrophagous beetles.

### Background

Silphidae is one of, if not the most important family of beetles in forensic entomology. They are typically characterized by their relatively large size, body shape, and club shaped antennae\(^3\). They are typically black, but may also have yellow, orange, or red markings. The majority of this family is associated with carrion, where the larvae typically feed on flesh and the adults feed on the larva of other species, eliminating competition.

There are two different subfamilies that differ depending on their behavior\(^3\). Members of the subfamily Silphinae colonize large carrion and exhibit little to no parental care, while members of the subfamily Necrophorinae tend to colonize smaller carrion and exhibit parental care\(^3\). The subfamily Necrophorinae is interesting in that it contains burying beetles, that may bury the carrion if it is small enough\(^4\).

*Necrophila americana*, the American carrion beetle, is a common necrophagous beetle in the Silphinae subfamily that is found east of the Rocky Mountains (Figure 1). These diurnal beetles feed on the larvae of flies and other beetles, while larvae feed on the carrion directly\(^4\). Another species, *Necrodes littoralis*, the shore sexton beetle, belongs to the subfamily Necrophorinae (Figure 1). This beetle is so common in Europe that in a study of over 150 French forensic cases, this species was found one case out of every eight\(^5\). These beetles are common on large vertebrate bodies, however, both adults and larvae feed directly on carrion and on Diptera larvae, although their preference follows that of *Necrophila americana*\(^6\).

### Further Research

Instar classification of forensically significant beetle species; difficult due to a lack of instar specific features\(^7\). Need to create more reference scales.

**Timelines of arrivals that are more specific; research into phenology, the study of seasonal cycles.**

**Interactions between Coleoptera species and organisms; antimicrobial compounds\(^8\), phoretic mechanically transported mites, and microbial hindgut communities\(^9\).**

**Effects of buried, burned, and immersed bodies, and premortem insect colonization.**

### Conclusions

Forensic entomology is extremely important to criminal investigations, and can more reliably determine PMI than traditional methods, by using the arrival and development of insects.

**Beetles, specifically the family of necrophagous beetles, Silphidae, are an important and interesting group that can be of significant value to the field of forensic entomology.**

### Relevance

Forensic entomology is a relatively new branch of forensic science, becoming common only in the past thirty or so years\(^1\). Entomological evidence is accepted in United States courts, and gaining acceptance in major European\(^1\).

Seventy-two hours after death, traditional pathological indicators of PMI are no longer reliable\(^1\). Insect developmental patterns can be used to accurately determine time of death after this period, especially when the body is in late decomposition. Using this method is more reliable than pathological indicators, making forensic entomology incredibly important to criminal investigations.

### References

4. Fun Fact: In North America, there are only four species in this group, with only species in the Pacific Northwest
5. The largest beetle family, with over 19,000 species, but only 14 species are associated with bodies
6. Over 1,500 species worldwide and 46 species in North America.
7. There are only four species in this group, with only species in the Pacific Northwest
8. The majority of this family is associated with carrion, where the larvae typically feed on flesh and the adults feed on the larva of other species, eliminating competition.
9. These beetles colonize bodies during the most active stages of decomposition.
10. There are only four species in this group, with only species in the Pacific Northwest
11. There are only four species in this group, with only species in the Pacific Northwest
12. There are only four species in this group, with only species in the Pacific Northwest
13. Different beetle species prefer different aspects of a carcass, including the stage of decomposition
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