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A Seventeenth-Century Beetle Fauna from Colonial Boston

ABSTRACT

A rich, diverse assemblage of preserved Coleopteran (beetle) remains was analyzed from the Feature 4 Cross Street Back Lot site in Boston, Massachusetts. This fauna represents the first large analysis of a Colonial site using the technique of archaeoentomology, resulting in the examination of over 2,000 individuals from 22 samples. The remains indicate that a rich composting environment existed in this feature which was composed of human and animal wastes, infested grain products, table wastes, and perhaps floor sweepings. From a biogeographic perspective, this study suggests that many European pest species were already established in New England by the 17th century, substantially altering our knowledge of their introductions.

Introduction

The identification of archaeologically preserved Coleoptera (beetles) for site interpretation, or archaeoentomology, is a technique of environmental reconstruction that has gone virtually untested in North America as a means of archaeological analysis. The rich organic preservation within many historical privies, however, provides the ideal preservation conditions for the application of this technique. The Feature 4 privy from the Cross Street Back Lot site (BOS-HA-13) in Boston, Massachusetts, represents the first large investigation of an historical privy for preserved Coleopteran remains.

This analysis examines questions of European biological imperialism in the historical beetle fauna. The introduction and subsequent displacement of native fauna by European species has been the subject of much discussion (Sailer 1983; Crosby 1986; Whitney 1994; Buckland et al. 1995), but has lacked the historical depth provided by analyses from pre-1800 contexts. Recent palaeoecological reconstructions by Schwert (1996) indicate the visibility of change in the North American beetle fauna during the historic period, but no specifically archaeological analyses have been undertaken. The City of Boston, as an early center of maritime trade bringing people and provisions to the Massachusetts Bay Colony, provides an ideal geographic setting from which to study these introductions. The privy may have been constructed as early as 1650, and represents, therefore, a Colonial context in which these questions of invertebrate introduction, change, and adaptation may be addressed. A total of 22 samples, from 8 subphases within the privy, provided 2,008 beetles, 64% of which are European or introduced species. This archaeoentomological investigation enriches our understanding both of the site and of the introduced European species that characterized the changing North American landscape during the Colonial period.

Methodology

The methodology for processing these samples follows that outlined by Morgan and Morgan (1990). Many identifications were cross-checked through consultation with the staff of, and by comparison to, the Canadian National Collection at Agriculture Canada in Ottawa, Ontario, Canada. Once identified, distributions and ecologies for each species were gathered, and it is these data that form the basis of the privy interpretation. The Coleopteran remains as provided in Table 1 are listed taxonomically according to Bousquet's (1991) *Checklist of Beetles of Canada and Alaska*.

Balicki (1995; Heck and Balicki this volume) has identified subphases I-2, I-5, I-8 and I-10 as deposition phases, which likely contained fecal material as well as wood, kitchen waste, and other debris. These subphases of the privy will be the focus of this discussion as they all contain a roughly similar fauna, with the number of individuals per sample generally correlating to sample weight as seen in Table 2. The fill subphases I-3, I-7, II-1, and II-3 contain a fauna reduced in number and species and were interpreted as sterile fill used to seal the lower level,

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TABLE 1
IDENTIFIED COLEOPTERA FROM FEATURE 4

COLEOPTERA
Carabidae
Bembidion tetracolum Say†
Bembidion sp.
Harpalus sp.
Stenolophus comma (Fabricius)
Chlaenius sericeus sericeus (Forster)
Carabidae spp.
Silphidae
Nicrophorus spp.
Staphylinidae
Carpelimus obesus (Kiesenwetter)†
Oxytelus sculptus Gravenhorst†
Anotylus insignitus (Gravenhorst)
A. rugosus (Fabricius)†
Neobisnius sp.
Philonthus politus (Linné)†
P. validus Casey
Philonthus sp.
Creophilus maxillosus (Linné)†
Quedius mesomelinus (Marsham)†
Quedius sp.
Neohypnus obscurus (Erichson)
Hydrophilidae
Cercyon haemorrhoidalis (Fabricius)†
C. praetextatus (Say)
C. terminatus (Marsham)†
C. analis (Paykull)†
Histeridae
Gnathoncus sp.
Margarinotus sp. or *Hister* sp.
Histeridae sp.
Scarabaeidae
Onthophagus pennsylvanicus Harold
Aphodius bicolor Say
A. granarius (Linné)†
Aphodius sp.
Ataenius spretulus (Haldeman)
Ataenius sp.
Trox scaber (Linné)†
Xyloryctes jamaicensis (Drury)
Elateridae
Elateridae sp.
Dermestidae
Dermestes lardarius Linné†
Dermestidae spp.
Bostrichidae
Amphicerus bicaudatus (Say)
Anobiidae
Priobium sericeum (Say)
Ptinidae
Ptinus fur (Linné)†
Ptinus sp.
Trogossitidae
Tenebriodes mauritanicus (Linné)†
Nitidulidae
Carpophilus hemipterus (Linné)†
Omosita colon (Linné)†
Nitidulidae spp.
Rhizophagidae
Monotoma picipes Herbst†
Cucujidae
Cryptolestes spp.
Uleiota debilis (LeConte)
Oryzaephilus mercator (Fauvel)†or *surinamensis* (Linné)†
Nausibius clavicornis (Kugelmann)†
Cryptophagidae
cf. *Atomaria ephippiata* Zimmermann
cf. *Atomaria* sp.
Lathridiidae
cf. *Lathridius minutus* (Linné)†
Corticaria sp.
Lathridiidae sp.
Mycetophagidae
Mycetophagidae sp.
Tenebrionidae
Gnatocerus cornutus (Fabricius)†
Tenebrionidae spp.
Bruchidae
Bruchus pisorum (Linné)†
Bruchus sp.
Chrysomelidae
Phyllotreta striolata (Fabricius)†
Chrysomelidae spp.
Apionidae
Apion sp.
Curculionidae
Listronotus sp.
Pelenomus fuliginosus (Dietz)
Sitophilus granarius (Linné)†
S. oryzae (Linné)†
Scolytidae
Hylurgopinus rufipes (Eichoff)
Orthotomicus caelatus (Eichoff)
Xyleborus affinis Eichoff
Pseudopityophthorus minutissimus (Zimmermann)
Gnathotrichus materiarius (Fitch)

† introduced species

privy modification and construction fill, possible percolation fill, and tub fill, respectively (Balicki 1995). Poor or fragmentary preservation was evident in two subphases, II-1 and II-3, which represent a percolation fill layer and wooden tub contents (Balicki 1995). In the remaining deposition levels, the preservation of the chitinous fragments ranged from good to excellent, with most species having intact characteristics necessary for their identifications.

Archaeoentomological investigations require an understanding, or at least a consideration of, the specific contexts created by humans in their inevitable alteration of the natural landscape. Questions regarding the culturally created or enhanced environment, and the indoor or house versus outdoor fauna must be considered (Kenward 1978, 1982; Hall and Kenward 1990; Kenward and Allison 1994). While it is not the aim of this article to review these concepts, they have been taken into account in the Feature 4 interpretations.

Interpretation

For interpretation purposes, the beetle fauna was divided into units according to their habitat requirements, although it will be demonstrated that some species may have exploited more than one locale.

The Pest Fauna

The entire pest fauna identified from Feature 4 is an introduced fauna that was likely brought to the Boston area with early settlers. These species, if occurring in large numbers, are serious pests of stored products such as peas and grain, though most Colonial households likely experienced some infestation regardless of their economic status.

Peas were purchased, stored, or grown at the site, as indicated by the introduced pea weevil *Bruchus pisorum*, recovered from five different levels. While there is no evidence of peas in the pollen or plant macrofossil evidence, the pea weevil is known to eat only field or garden peas (Campbell et al. 1989); therefore its appearance clearly indicates the presence of peas. Documentary records show the pea weevil was doing damage to crops in the colonies as early as 1675; it was thought to have spread north from Philadelphia (Russell 1982:78). Records also attest to the shipment of dry pea seeds to the Massachusetts Bay Colony as early as 1628 (Russell 1982:12), allowing for the establishment of this pest long before the construction of the Feature 4 privy. Infestation of the peas begins in the field, but the individual weevils do not emerge until the peas are in storage after harvest; their presence may go undetected for quite some time (Campbell et al. 1989). If thoroughly infested, the peas are inedible (Campbell et al. 1989) and must be discarded, making wholesale disposal a potential explanation for the presence of *Bruchus pisorum* in the privy. Equally plausible is the suggestion that the bruchids may have been ingested in pea soup or some other pea dish, entering the privy in human feces.

Species related to infested grain products include *Sitophilus granarius*, *S. oryzae*, *Gnatocerus cornutus*, *Oryzaephilus surinamensis* or *mercator*, and *Tenebriodes mauritanicus*. *S. granarius* is a flightless weevil which is anthropochorous or dependent on humans for transport. *S. granarius* and *S. oyzae* represent two of the most destructive stored-grain pests, capable of destroying the contents of an entire store of grain (Campbell et al. 1989). Species of *O. surinamensis* may live in a variety of habitats which include stored products, though they have also been collected from any number of plant products (Campbell et al. 1989). In the Colonial period these species were likely an unwanted yet normal component of the diet. The grain-related species may have entered the privy deposit as fecal remains, floor sweepings, or in the discarding of infested grains. Kelso (1995) has found unusually high levels of Eurasian cereal pollens in this privy that appear to indicate the discarding of infested flour. As no cereal grains were recovered in the plant macrofossil analysis (Kaplan et al. 1995), this

TABLE 2
STRATIGRAPHIC LOCATION OF COLEOPTERAN FAUNA IN FEATURE 4

Date MCD	TPQ	Subphase	Event	HN	Total MNI	Sample Weight	Comments
		IV	Feature 1, late privy	92			
1745	1840	III	Close drain feature	98, 97			
1713	1670	II-3	Tub matrix	122	4	1.53 kg	beetle remains poorly preserved
1695	1700	II-2	Clay around tub drain	99, 91			
1697	1670	II-1	Possible percolation fill	125	103	2.79 kg	beetle remains poorly preserved
1702	1670	I-10	Fecal deposit	100	758	12.55 kg	decomposer fauna, with *Carpelimus obesus*, *Anotylus rugosus,* and *Cercyon terminatus* able to overwinter and reproduce the following season
		I-9	Construction	various			
1703	1690	I-8	Fecal deposit	146	695	18.30 kg	rich in ptinid fauna, likely part of house fauna introduced in floor sweepings
1699	1650	I-7	Privy modification and construction fill	149	48	2.37 kg	poor in beetle remains since is construction fill
		I-6	Cleaning	164			
1695	1670	I-5	Fecal deposit	148	292	18.26 kg	first evidence of pea weevil, pest fauna is established as is decomposer fauna, I-8 and I-10 contain similar faunas
		I-4	Cleaning	165			
1705	1630	I-3	Capping fill	151-153	21	6.65 kg	sparse fauna, most species represented by only a few individuals
1699	1650	I-2	Fecal deposit	154	87	10.62 kg	contains only true carrion feeders, appearance of European species
		I-1	Privy construction	various			
Totals					2008	73.07 kg	

interpretation seems likely. The grain beetles as well as the mold and fungus-related species discussed below may indicate the presence of moldy flour.

Many of the identified pest beetles are not host specific and may have thrived on a wide variety of foodstuffs. *Nausibius clavicornis* may be found on sugar, but has also been taken on dried fruits and spices (Breese and Wise 1959). *Ptinus fur*, the golden spider beetle, is an omnivore. At the Cross Street Back Lot site it was likely a part of the indoor household component of beetles (Osborne 1981), though modern studies consider this species to be an indicator of unsanitary storage conditions (Campbell et al. 1989). This species, therefore, has been found in grain stores (Hall et al. 1980) but can easily find suitable habitats in any number of areas within domestic dwellings.

The sole species indicating the presence of vegetables is *Phyllotreta striolata*, the striped flea beetle, a pest of living cruciferous vegetables such as turnips, radishes, and cabbage (Smith 1985). It is a highly destructive beetle as it damages the leaves as they appear above ground in the spring (Campbell et al. 1989).

Ptinus fur and *Tenebriodes mauritanicus* are European pests that are regarded as 19th century introductions (Campbell et al. 1989; Bousquet 1990), while *Phyllotreta striolata* was considered to be a pre-1801 introduction (Smith 1985). *Sitophilus granarius*, a common pest, was likely introduced in the 17th century (Buckland et al. 1995), evidenced in the colonies by the arrival of infested stores. The pea weevil, *Bruchus pisorum*, is the only species from this fauna that is known to date from the occupation period of the site (Sailer 1983), indicating either a deficiency of information in the documentary sources or lack of observance of these species. Sailer (1983) notes that many introduced species probably arrived here earlier than expected, and went unnoticed because of their innocuous nature.

The Compost and Dung Fauna

Many beetles from the families Staphylinidae, Scarabaeidae, and Hydrophilidae are dung and compost generalists, and these represent over half the individuals identified from this privy. The four hydrophilids of the genus *Cercyon* are attracted to decaying matter generally as well as to dung (Smetana 1978; Kenward and Allison 1994). Animal wastes and accumulations of rotting plant debris may have attracted these beetles, although sometimes human dung provides a suitable alternative. *C. terminatus* is the most abundant hydrophilid species at this site and represents an environment with wet plant matter and dung (Hall et al. 1983). Like other introduced species discussed in this text, *C. terminatus* was thought to have been introduced in the 1800s and is not a common beetle today, though it is evident that it was well established in the Boston area by the late 1600s.

The general dung and compost feeders of the staphylinid family found in the privy are *Carpelimus obesus*, *Philonthus politus, Creophilus maxillosus*, *Oxytelus sculptus*, *Anotylus insignitus,* and *A. rugosus* (Hammond 1976; Hall et al. 1983). These species feed on leaf litter, moss, dung, compost, and all types of decaying material. *Trox scaber*, an introduced scarab and occasional carrion feeder, may also fit equally into this category of decomposer insects attracted to rotting matter (Hall and Kenward 1990), while Kenward and Allison (1994) suggest that it may have been part of the domestic household fauna.

Aphodius granarius, the sole introduced dung beetle, feeds on large mammal dung, decaying vegetables, and compost (Landin 1961; Gordon 1983), which it colonizes rapidly (Osborne 1981). In his discussion of European introductions, Sailer (1983) hypothesized that this beetle was introduced in the 17th century with the provisioning of cows to the colonies. Like the staphylinid fauna, the scarab species are often eurytopic (di-

versified or varied) feeders. *Ataenius spretulus* is a general dung and compost feeder (Hoffman 1935; Cartwright 1974) and *Onthophagus pennsylvanicus* may be found on dung or rotting fruit (Howden and Cartwright 1963).

Kitchen wastes, organic yard debris, and fecal remains would have all provided the suitable nutrients required by many of the species in the dung and compost category of beetles. In fact, it is the parasite analysis (Driscoll 1995) that clearly indicates that at least a proportion of these deposits was composed of human fecal remains.

The Carrion Fauna

The carrion fauna of the privy is demonstrated by species that indicate carrion disposal and decay within the privy. Beetles of the *Nicrophorus* genus are general carrion feeders native to eastern North America (Anderson and Peck 1985) and were recovered from the lowest level (subphase I-2), which contained a juvenile pig skeleton (Balicki 1995; Heck and Balicki, this volume) that may have attracted them.

Occasional carrion feeders include the introduced species of *Trox scaber* (Vaurie 1955), *Dermestes lardarius*, and *Omosita colon* as well as the staphylinids *Quedius mesomelinus*, *Creophilus maxillosus*, and *Philonthus politus* (Hinton 1945; Osborne 1983; Campbell et al. 1989). These beetles, in conjunction with the histerids, likely fed on maggots in decomposing meats. As mentioned, these species are not exclusively carrion feeders and may also have been attracted to the rotting foul matter of the privy generally.

The Mold and Fungus Fauna

Several families of beetles represent mold and fungus feeders. When found in stored products, their presence is indicative of poor or damp storage conditions as they feed on mold or fungus associated with stored foods and grains but are not directly damaging to stored products (Bousquet 1990). At this site they likely inhabited several places, arriving in the privy in house sweepings, discarded grains, or living within the privy itself, so rich in decaying organics. The mold and fungus feeders include *Uleiota debilis, Monotoma picipes*, *Atomaria ephippiata*, and *Lathridius minutus* as well as other individuals that could only be identified to the genus level.

The Urban Environment

A very small proportion of the beetle fauna indicates the use and presence of wood in or around the feature. Wood-related species may occur in the privy as feeders on several sources, including the privy's wooden sill and planking, a woodpile, buildings, wood debris, or the occasional fruit or ornamental tree. The scolytid or bark beetle *Pseudopityophthorus minutissimus* may indicate the use of oak (Bright 1976), while the native scarab *Xyloryctes jamaicensis* is often taken from beneath chestnut bark (Ritcher 1966). *Hylurgopinus rufipes* and *Orthotomicus caelatus* thrive on weakened or dying trees (Wood 1982), while *Gnathotrichus materiarius* lives on healthy conifers (Bright 1976). These species could have easily found suitable habitats in or around the privy feature. *Priobium sericeum* may have been discarded into the privy in sweepings, as it is usually found in domestic settings, damaging floors and timbers (White 1975). The apple twig borer, *Amphicerus bicaudatus*, has a preference for twigs and trees bearing apples, pears, and cherries (Fisher 1950), the latter of which was represented by large volumes of pits indicating fruit consumption and preparation.

Discussion

The site appears to contain three faunas: outdoor, privy, and house. While a few species may have been affiliated with more than one of these faunas, the beetles divide into the three groups according to both biological needs and comparative site data.

One component of the small outdoor fauna is a group of wood-related species, such as the scolytids that indicate the presence and probable use of both coniferous and deciduous trees. The *Aphodius granarius* dung beetles may also have been part of this outdoor assemblage if herbivorous mammals were near the site (Schwert 1996).

The privy fauna is harder to define. The silphid beetles, such as those from the genus *Nicrophorus* and some of the occasional carrion feeders belong to this group. The domestic structures at this site may have provided equally suitable habitats for carrion feeders, as they would have been locations for fresh or dried meats and their associated fly fauna. An established privy fauna is evidenced by the three species of *Carpelimus obesus*, *Anotylus rugosus*, and *Cercyon terminatus*, which would have been attracted to the foul matter and fecal remains in the privy. In subphase I-10, these species each number over 100 individuals, indicating their ability to overwinter and reproduce in the fecal layer. This overwintering group is similar to one identified by Osborne (1981, 1983) in his investigation of a medieval barrel latrine. The occasional dung feeders and composting beetles are also part of the privy fauna group.

British researchers have identified what appears to be a house component in archaeologically preserved beetle assemblages, consisting of species that are consistently linked to house structures (Hall and Kenward 1990). The Feature 4 material which belongs to this element is represented by *Ptinus fur*, *Ptinus* sp., cf. *Lathridius minutus*, *Trox scaber*, and perhaps *Cercyon analis* and *Atomaria* sp. If the domestic home or associated structures such as wooden outbuildings or sheds were damp in nature, this group of species would be able to find exploitable habitats within the dwellings. They therefore entered the privy in floor sweepings. Species such as the fungus-feeding *Lathridius minutus* has not always been associated with human occupation and originally lived in a more natural, rather than cultural, setting. It has been suggested that as the available natural habitats for fungus-feeding species diminished, and as towns got cleaner, *L. minutus* became a stored-product pest or found other suitable habitats that mimicked its requirements in nature (Kenward and Allison 1994).

The infesting grain and pea beetles, also part of the indoor component, likely lived in the home or adjacent buildings and four possible routes of entry explain their presence in the Feature 4 structure. They may have entered in rotted foods that were so badly decayed they demanded discarding, in table scraps, floor sweepings, or excrement. Eating experiments by Osborne (1983) demonstrated that a soup or gruel containing *Sitophilus granarius* and *Oryzaephilus surinamensis* can be ingested and defecated without damaging the identifiability of the beetles, and some even survive this journey articulated. In the interpretation of archaeological deposits, therefore, we cannot clearly distinguish between rotted food items and excrement using beetle remains alone. In Feature 4, some of the bruchids and weevils likely fall into this excremental category, while some of the household dwellers entered as kitchen wastes and sweepings.

It has been hypothesized by both this author and by Kelso (1995; Kelso this volume), that, during the use of this privy, the household flour store was so badly infested that it was thrown into the privy. This appears to be the sole plausible explanation for the extremely high levels of Eurasian cereal pollens (Kelso 1995). If this were the case, the rotting flour may also be responsible for the presence of some of the ptinid and fungus-related beetles. While it is impossible to state unequivocally whether the rot of some flour caused its eventual discard, it must be noted that the tolerance of intruders in the diet would have been much higher than today, as the

inhabitants of 17th-century Boston did not share our modern-day demands for cleanliness and sterility.

Feature 4, with its three faunas, is similar to Osborne's barrel latrine (1981). His assemblage contained many of the same families of dung, compost, and stored-grain species. Like Osborne's feature, the Nanny-Naylor privy is also seen as a closed environment, as there are only minimal amounts of contaminating species, that is, species from the surrounding environment relative to the total fauna. One question that must be addressed is to what degree were stores invaded with what we now term "infesting" and "pest" species? At what point was an insect considered a pest and when did it stop being just a slightly crunchier part of the daily bread?

In this assemblage, there are 24 species of beetles introduced from Europe. They number 1,278 individuals and make up 64% of the assemblage. The beetles indigenous to North America comprise 20 different species but make up only 10% of the fauna, represented by 193 individuals. The remaining beetles could not be identified to the species level, but a large number appear to be introduced. Thus it can be conservatively estimated that at least 64% and perhaps as high as 80% of these Coleoptera are introduced species, or non-native to North America. During the Colonial period they were likely introduced from Britain and from other colonies via the shipping trade. Many were thought to have arrived in eastern North America in the 1800s, conveniently coinciding with the first systematic insect collecting records. In Coleoptera alone, there have been more than 300 species that have made the transition from the Old to the New World, particularly in the Maritime provinces and New England (Buckland et al. 1995). To the best of the author's knowledge, Feature 4 is the earliest known record of 20 of the 24 introduced beetles, setting the dates of introduction of many species 100 to 200 years earlier than expected. With knowledge of these early introductions, the reaction of potentially damaging species to this new environment can be studied as we can begin to trace their dispersal across the landscape, as they find congenial homes, and at times, displace native species (Crosby 1986; Mrozowski 1987; Buckland et al. 1995; Schwert 1996). While many recent publications lament the dearth of pre-1800 data (Elias 1994; Buckland et al. 1995; Dirrigl and Greenberg 1995; Sutton 1995), the Feature 4 beetle fauna begins to track this biological imperialism leading to the progressive Europeanization of the North American landscape. The privy feature represents a domestic environment rather than pasture or garden areas yet clearly contained a huge proportion of European species, indicating the ease with which these species were able to find suitable homes after their trans-Atlantic voyage.

Conclusions

This beetle assemblage reconstructs a deposit rich in organic debris, containing yard and kitchen wastes, floor sweepings, and nightsoil. While it appears there was some general infestation of meat, vegetable, and fruit products, a normal aspect of life in the 17th century, the household flour store may have been so infested it was rendered inedible. This archaeoentomological study of the privy augments the interpretations of other participating researchers and begins to outline the biogeographic history of 24 introduced beetle species in North America and provides a significant archaeological and ecological contribution.

The European nature (64%-80% of the MNI) of this 17th-18th-century fauna reflects Boston's role as a central point of entry into the New World, with marine traffic easily providing a means for the introduction of new species. Beetles analyzed from Feature 4 begin to track these early introductions which were radically altering the North American landscape, inflicting a European biological imperialism upon the native flora and fauna. As this represents one of the first archaeoentomological analyses of this ongoing transition, more comparative faunas are

needed to contextualize this assemblage with other suitable North American sites, and to better understand this Europeanization of 17th-century Boston and of the "Neo-European Seedbed" (Crosby 1986) that was eastern North America.

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