

## ENTOMOLOGY: AN AID IN ARCHAEOLOGICAL STUDIES

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### ABSTRACT

Sampling for insect remains was conducted at the ruins under excavation at Wetherill Mesa during 1961 and 1962. The mesa-top samples were unproductive; the more-protected cliff dwellings offered better results. The fragile nature of insect remains requires special procedures in their separation and preservation from the samples of soil, adobe, mortar, fecal matter, and other material collected for study. Insect species were found that could have been pests in stored grain as well as in the farmlands. Other insects, chiefly beetles, were recovered that might be classified as household pests. Scavenger insects, mainly tenebrionids, scarab beetles, and flies, were associated with turkey roosts, pack rat nests, fecal matter, and burials. Twenty-four specimens of human feces were studied; only one sample contained insect remains - grasshopper parts - that could have been ingested. Insect activity on timbers was observed. It is possible the Indians felled the trees and permitted bark beetles and borers to "work" on the trees, thus loosening the bark for easier stripping. Although this study was not as comprehensive as might have been hoped for, results indicate that entomological study should certainly be useful in archaeological investigations.

Entomological evidence has seldom been collected in archaeological investigations although its usefulness seems promising. The remains of insects and to a lesser degree their work are among the most durable of natural materials. Chitin and the silk used by insects in their cocoons and cases are practically immune to decay and deterioration and, if undisturbed and therefore unbroken, will remain unchanged for centuries. Chitinous parts even pass through the digestive tracts of mammals or birds and are still recognizable. However, the chitinous and other remains of insect are fragile and may break at a touch. For this reason, they are often broken and therefore overlooked during excavation. As a result much information that would contribute to archaeological research is lost. The tunneling of insects in wood will persist as long as the wood remains intact, and the evidence of feeding by insects will be evident as long as the materials on which they have fed remain identifiable. If we know the habits of the various insects, the entomological evidence found in archaeological excavations may provide a key to some customs of their human associates.

The objectives of this paper are to indicate the kinds of entomological evidence that may be useful to the archaeologist, where this evidence is most likely to be preserved, and how

entomological remains may be collected, preserved, and interpreted. These matters will be illustrated by entomo-archaeological studies conducted since 1961 during excavations on Wetherill Mesa, Mesa Verde National Park, Colorado.

Unfortunately, adequate financial support for a comprehensive entomological study at the modern level could not be obtained. Consequently, intensive field work was limited to the season of 1961 and a short period during the following summer. Subsequent collections, however, were made by the field archaeologists excavating the ruins. Insect materials were separated in the laboratory and mounted on slides. This material has since been identified and the results of all work are summarized herein.

Researches reported here are necessarily incomplete. Some positive conclusions, however, have been drawn from the data gathered and certain postulations have been formulated. These must ultimately be verified or modified by later research.

One general conclusion seems clear; that is, under conditions existing in the ruins at Mesa Verde, especially in the cave dwellings, an abundance of useful entomological evidence is present. Some of this can be interpreted on the basis of our present knowledge of the insects and their habits, whereas other interpretations must await further entomological study of the modern insect fauna of the locality and further collections from ruins.

Useful Kinds of Evidence

The materials or remains that seem most valuable are: (a) whole insects or identifiable parts of recognizable species; (b) recognizable results of the activity of known species; (c) recognizable remains of specimens belonging to insect groups which all have similar habits.

The value of specimens is increased if they are collected in locations where they can be assigned to a specific archaeological period. If, on the other hand, modern species could have had access to the location where a specimen is found its value becomes dubious from an archaeological standpoint. Thus the uppermost layers of wind-borne or water-washed materials are unlikely to contain specimens of special interest. In contrast, specimens recovered from beneath packed walking surfaces or in the adobe clay used for roofs or floors almost certainly reached the point where they were found during Indian occupancy. In some instances the approximate time that they were alive can be determined. Also, specimens found in buried vessels, or associated directly with undisturbed burials are definitely ancient. However, if a burial has been disturbed by burrowing animals or by previous excavations the significance of insect remains associated therewith might be doubtful, except for those which could only have lived on the burial such as flesh flies, blow flies, and other scavengers actually within the chest cavity.

Another source of significant entomological information is to be found in pieces of wood used in construction. Freshly cut wood is almost invariably attacked by bark beetles, phloem borers of different species, and wood borers. The species of insect or at least the group involved can be recognized accurately. (This will be discussed later.)

The study of insect work in timbers combined with that of the dendrochronologist can add much to an understanding of some Indian customs. Also the effects of insects upon trees while they are alive, because they can often be distinguished from weather effects in the annual ring patterns, may aid the dendrochronologist in interpretations that will be useful to the archaeologist. For example heavy defoliation over a series of years produces a distinct ring pattern on the individual trees that are defoliated. In the case of certain tree species, Douglas-fir, for instance, this evidence is clear; in other cases further research is needed in order to recognize the pattern with precision. These studies must be made upon individual trees because, as we have found, the averaging of the growth measurements from a series of trees can obscure the defoliation pattern.

#### Collecting and Preserving Insect Remains

The insect remains are buried in the ruins, either in accumulations of loose materials or enclosed in pieces of adobe clay, and must be separated very gently, or the already tiny remains will be further reduced. During the field season of 1961 various sorting procedures were tested. The simplest and by far the most

productive was a washing and screening process (Colyer and Osborne, this volume).

Ancient insect remains are far more easily broken than are modern dried insect specimens. The latter specimens consist not only of the external chitinous parts but also the dried muscular layer with the exoskeleton. This layer of dried tissue serves to strengthen the specimen and hold it together. In the specimens from the ruins, practically all of the soft internal parts have been destroyed by various organisms leaving only the chitinous parts with very little to hold them together. It was hoped that ancient specimens could be preserved in alcohol, but when placed in this liquid they broke up.

The fragility of insect remains and the care that must be used in their separation, preservation, and study add up to the conclusion that archaeologists cannot be expected to detect such remains in the field using the accepted excavation procedures. Only the larger insect specimens or those enclosed within protective coverings, cocoons, or the like are apt to be detected. However, by collecting samples of soil, adobe, mortar, feces, or other material and washing out the specimens contained in them, much significant information about the insects associated with the ancient inhabitants can be recovered. The interpretation of these findings requires the aid of an entomologist who must also be personally familiar with the excavations.

Entomological Evidence from Mesa Verde Studies

Samples from which insect remains were separated were collected from all ruins under excavation on Wetherill Mesa during 1961 and 1962. Samples from the unprotected ruins on the mesa top were unrewarding and will therefore not be discussed. The opposite was true of the protected cliff dwellings. Those from Long and Mug Houses were collected after excavation was almost completed. They were taken from a few spots of undisturbed material, from adobe removed from the ruins, from undesignated locations in the process of excavations, and from the few rooms that had not been completely excavated.

Samples from Step House were more complete, most of them being collected by Robert Nichols in 1962. The insects recovered from this site were members of practically the same groups collected in smaller number from Long House and Mug House in 1961. The large number of samples and their wider distribution in various parts of the Step House lend confidence that the earlier findings were representative. The series includes samples from both the very old Basketmaker structures and the more recent Pueblo ruins. All the data combined leads to the conclusion that throughout Indian occupancy the insects associated with these people were essentially the same.

Some insect species that were found could have been pests of crops in the field and some could have been pests of stored materials. Unfortunately, however, the plant products found in the ruins were distributed directly to other specialists before they could be examined for insect remains or work. Some entomological evidence of

crop pests may thus have been lost. A few specimens were sorted out by the agricultural plant specialists and by Wetherill Mesa personnel for my examination.

#### Potential Pests of Stored Grain

That the stored materials were as free from insect pests as they appeared to be is a conclusion difficult to accept. Even edible materials sealed tightly in jars must sometimes have contained insects. Such materials would likely be completely reduced to powder before being excavated, whereas the uninfested stores could keep indefinitely. Of course, deterioration of infested grain would not be due to the action of the insects alone. For example, if grain were infested by seed eating insects when sealed into a vessel the insects would continue to feed on the grain and multiply. Insects that feed on dry seeds, such as bean weevils, produce more metabolic water than is needed to meet their water requirements. This would accumulate in a tight vessel thoroughly moistening the contents and creating physical conditions favorable for decomposition by microorganisms. The end result after centuries, would be an unrecognizable powder. This phenomenon can be demonstrated experimentally by sealing infested dry beans in a glass jar. But whether or not it happened in the ruins, reasonable though the hypothesis may seem, can only be conjecture. Most of the dried stored products found showed little if any evidence of damage by insects, although beetles known to feed on grain were recovered from the ruins.

These seed eaters were tenebrionid beetles, a family comprised of grain insects, scavengers, and general feeders. One grain pest was Cyaneus angustus Lec. Although not especially common, this beetle has been reported as a pest of stored grain in elevators in midwestern United States and Canada. The species was washed from adobe from Mug House, and beetle parts of the same genus and apparently the same species were recovered from five different locations in Step House.

The other tenebrionid that was recovered very frequently from the ruins belongs to the genus Platydemus. Whether or not this was chiefly a grain pest is open to question, because the parts recovered could not be identified to species. However, it was found associated with seeds, was washed from adobe, and was associated with both human and turkey fecal material. This form might well be Platydemus ruficornis, a species reported in literature as a pest of stored corn (Farrar and Flint 1942). The association of a corn pest with ancient Indian feces can be logically explained by the presence of undigested corn in this material. Therefore, we may safely say that probably, but not certainly, Platydemus was a pest of dry corn. This needs further verification.

#### Household Pests and Scavengers

The insects that might be classified as household pests were similar to those found in homes today. They were chiefly beetles belonging to the families Dermestidae, Ptinidae, and Scarabaeidae.

The most abundant insect among the household pests was an undescribed ptinid, a species close to Niptus abdictus, according to W. D. Brown (personal correspondence) Entomological Research Institute, Canada Department of Agriculture, Ottawa. The cocoons of this beetle were first identified as being those of a moth similar to the clothes moth. This same error was apparently made by Vogt (1960). Later this error was corrected when a beetle was found that had died in the process of emerging from its cocoon. This observation, together with the presence of fragmental cast skins of ptinid larvae and the characteristic beetle frass mixed with the cocoons and in the insect's tunnels, showed that the cocoons could not be those of a moth. The work of this ptinid was first observed in abundance in corn trash, where it had tunneled into the stems and cobs, and had fed on the dried leaves. It was observed wherever corn trash was found in the excavations. In the Step House samples, the beetle was in association with many different kinds of organic materials, including human feces, and was washed from adobe. Another similar ptinid, N. ventriculus, was also present but in much smaller numbers. These beetles are close relatives of common beetles that feed upon a wide variety of food materials in our modern kitchens. Niptus (new species) must have infested various food materials of the Indians.

The dermestid beetles were also numerous, especially those belonging to the carpet beetle group of the genus Attagenus. The common larder beetle that we commonly find infesting our food and specimens of insects and vertebrates in museums occurred less frequently in the ruins. This is probably because the dermestids prefer to feed upon animal materials which occurred in the ruins much less frequently than plant materials. Nevertheless, they would be considered numerous among the insect associates of the ancient Pueblos and must have caused considerable damage to their skin and feather clothing.

Representatives of insect groups that one should expect to find in the ruins were not present in our samples. For example, the human parasites such as lice were not observed in the samples, although the eggs of these insects were conspicuous in the hair of certain mummified human remains from the Mesa Verde cliff dwellings. Predaceous bugs that are commonly found in pack rat nests and sometimes within modern dwellings must have been present, but were not observed. Therefore, we may conclude that our samples were not sufficient to give a complete picture of the insects associated with the Indians. Nevertheless, they are representative and show how entomological studies can contribute valuable information.

The scavenger insects were associated especially with turkey roosts, pack rat nests, fecal materials, and burials. These were chiefly tenebrionids, scarab beetles, and flies. Many of the

unidentifiable remains of insects may quite likely belong to this group. Some burials were heavily infested with blow flies of various kinds, whereas others were free of these insects. Sometimes masses of fly puparia could be picked up by the handful from within the chest cavity of a skeleton. In such instances the eggs must have been deposited on the body while it was being prepared for burial. This is what would be expected if the death occurred during warm weather. During cold weather, on the other hand, no infestation by flies would occur. Therefore, the presence or absence of fly puparia may indicate the period of the year when the death of the individual occurred. Surprisingly few puparia found with the skeletons were common blue bottle or blow flies. By far the most numerous were flesh flies of the family Sarcophagidae. However, flies of several other families were represented in smaller numbers.

Some tribes of modern Indians use insects for food, therefore we expected to find evidence that the Mesa Verde Indians might have used grasshoppers or moth pupae for food. The chitinous parts of such food would pass through the digestive tract and remain identifiable in the feces. A considerable amount of human feces was recovered from the cliff dwellings. Most of this material was examined by others who did not report observing insect remains. Twenty-four specimens were carefully examined in the laboratory at Mesa Verde with the special objective of recovering any insect parts that were present, and another set of about the same number were examined in Ann Arbor. Only a single fecal specimen contained

insect remains other than scavenger species that must have infested the materials after they were deposited: there were a few grasshopper parts, by no means enough to constitute a meal. The use of insects as food by the Mesa Verde Indians, therefore, probably was not common. Parts of insects were recovered from turkey droppings showing that the ancient turkey found such food attractive just as our modern birds do. A moth pupa very closely related to the pandora moth was recovered from the ruins but not from feces. This is a common food of some California Indians.

#### Potential Pests of Crops

One may safely assume that the agricultural Indians of Mesa Verde must have been plagued by insect pests in their fields. However, little evidence of field infestations was found in the excavations. A single sample of beans, infested either while in the field or while still soft, by a weevil-like insect, was observed. Quite likely, infested corn, beans, and other seeds were sorted out and either used immediately or destroyed. Also infested vines and stalks might possibly have been burned. Although accumulations of corn leaves and stalks were found in various rooms, they showed little evidence of insect feeding that might have occurred in the field. A few cobs showed evidence of feeding by some caterpillar similar to the corn earworm, but if this was a common type of injury most of the evidence must have been destroyed by the Indians or did not survive the centuries.

Two insect families that could have caused injury in the fields were recovered from the ruins. These were the adult beetle of white grubs and the adults and larvae of false wireworms. Both groups are injurious to modern crops.

The insects of the first group are root eaters in the larval stage, whereas those of the second group are pests of germinating seeds. Both adults and larvae of the false wireworms are known to cause severe injury to planted grains in dry localities. These false wireworms, genus Eliodes, are called stinkbugs locally because of the odoriferous substance emitted by the adult beetles when disturbed. The beetles have the habit of dropping their heads to the ground and elevating the opposite end of their bodies when they are frightened. This characteristic attitude has caused some of the Indian workmen in the ruins to draw a comparison between the beetles and the attitude assumed by archaeologists in searching the surface for artifacts. Some have been known to refer to certain archaeologists as "stinkbugs"

The false wireworms were relatively numerous in the ruins, and modern beetles of the same genus were numerous on the mesa. The two species recovered from the ruins were not collected alive on the mesa, but the chances seem good that further search would disclose that they are still a part of the modern fauna.

The root-eating white grubs were represented in the ruins by a single species, Polyphylla crenata Lec. This large brown white-striped scarabaeid was collected alive on the mesa and its remains

were found in the ruins beneath the adobe floor of Kiva G in Long House. Five unbroken beetles were discovered immediately beneath the uppermost of several floors that had been laid one above the other. The beetles must have developed from the larval stage in the material beneath the floor. This consisted of windblown or water-washed soil, mixed with chunks of adobe clay from a collapsed roof. Presumably the kiva's roof had collapsed, but later it was rebuilt. The larvae of these beetles must have a fairly dense mass of living roots to feed upon in order to develop to maturity. Therefore, the soil in which they were found must have supported sufficient vegetation on which the larvae were feeding at the time the kiva was repaired and an adobe floor laid. The beetles could not penetrate the new floor when their development was completed. As a result they were unable to emerge and died just below the lower surface of the floor.

This indicates that Kiva G had been abandoned long enough for the accumulation of fine debris between the chunks of adobe from the collapsed roof, thus forming a soil layer in which plants could grow. An additional period must have elapsed permitting the invasion and establishment of vegetation without which the larvae could not have developed to maturity. It would appear that Kiva G in Long House was abandoned for many years before being rebuilt.

A photograph of Long House prior to the recent excavation indicates that the area of Kiva G was then occupied by vegetation.

Therefore, the area was far enough <sup>from</sup> beneath the overhanging cave roof to receive water in sufficient quantities to support plants. Invasion of herbaceous plants could have occurred within a few years after soil over the floor below had been accumulated in sufficient quantities to support plants.

The question may well be asked did this period of abandonment represent a period when all of Long House was unoccupied or did the Indians abandon only a part of their pueblo while occupying other parts? Evidence from insects alone cannot answer this question.

From our experience in modern agriculture we know that when we grow single plant species, we are invariably faced with serious insect problems. The Indian's fields almost surely would have been subjected to severe periodic insect infestations that could be triggered by such factors as dry weather. Pests that are innocuous under wild conditions often increase in number under cultivated field conditions, especially where a single plant species is grown. Examples are the corn root worm, stalk borers, the Mexican bean beetle, aphids and leaf-hoppers of many kinds, virus, and fungus diseases, and hundreds of other potential pests. Any of these organisms could destroy an entire crop when present in excessive numbers. Today we have at our disposal insecticides and fungicides. Without these we could not grow any crop in fields year after year without failures. The Indians could only hand pick

the noxious organisms from the plants, burn infested materials (if they did so), and if these means failed, move to a virgin area.

A very logical sort of agrarian practice for the Mesa Verde Indians could have been the alternation of farming areas; cultivating one area until the pests got the upper hand and then moving to a new field. Later, when natural forces had reduced the pests to normal numbers the original field could again be used.

With the growth of the Indian populations that would logically be expected under an agricultural economy, the opportunity to move to different locations in order to escape the devastation of pests would diminish. Ultimately, we can easily imagine a situation where the devastation by pests might have become so general as to force the abandonment of the entire Mesa Verde locality. Is this what happened immediately prior to A.D. 1300? No one can say, on the basis of present evidence, but this possibility is as logical as some others that have been proposed.

#### Insects Evidence in Timbers

During the 1961 field season, structural timber then available from Long House and Mug House was studied by Robert Nichols and myself. Ninety-five logs were examined carefully for signs of insect activity. An additional 10 timbers either were so badly eroded that the surface layers had been destroyed, or their surfaces had been so completely mined by termites that any evidence that may have been left by phloem or phloem-wood insects was obliterated. In addition, the exposed portions of three pieces of in situ juniper were so heavily smoked that possible insect tunnels

were concealed. These 13 pieces have not been included in our percentage calculations because their status is uncertain. Almost all the pieces showed evidence of attack by insects. Evidence of insect activity was seen on all of 20 pieces of Douglas-fir, on 93 percent of 43 pieces of juniper, on 94 percent of 17 pieces identified as pinyon pine, and all of 15 pieces identified as ponderosa pine. Roughened wood surfaces indicated that other pieces had been attacked by phloem insects that had not scored the wood, but these were not included in the above percentages.

The relative proportion of tree species found in the ruins as suggested by the above figures is misleading. Nichols finds from more extensive studies of timbers and charcoal that ponderosa pine in general constitutes only a trace in comparison with pinyon and juniper. He also finds that the proportion of Douglas-fir in our 1961 sample of 94 trees is in excess of that characteristic of the ruins in general.

The species of insects that had attacked the timbers were identical with those that attack each host species at the present time. For the most part they belong to three families of beetles; the flat-headed borers, the round-headed or long-horned borers, and the bark beetles. Representatives of each insect group were observed on timbers of each tree species, although the different kinds of trees usually were characterized by different insects.

All these insects attack dying or freshly cut timber and seldom injure healthy trees. Because dying trees do become infested, there is the possibility that the Indians cut a few dead timbers that had previously been infested. That this happened often seems unlikely for two reasons. First, one would not expect an Indian using a crude stone axe to cut a dead tree when a green one that could be cut more easily was available. Second, very few of the timbers examined had exit holes of wood borers although the tunnels of these insects scoring the surface of the wood were evident. This indicates that before they had a chance to enter the wood the insects had died. This would happen in a log from which the bark was removed while the insects were still in the larval stage beneath the bark.

The amount of scoring by insects and the relative abundance of the different kinds of insects varied from timber to timber. We know that some bark beetles and borers are affected by weather conditions.

Studying a large series of timbers cut at different times and comparing the relative abundance of different insects from period to period could be very rewarding. It could relate the variations in the abundance of various species of insects with variations in weather, forest fires, insect outbreaks, and other occurrences. The number of samples included in this study was too limited to permit even tentative conclusions, but such research should be encouraged.

Several interesting conclusions may be drawn from our examination of timbers from Long House and Mug House. The insect biota was much the same in juniper and pinyon logs as it is today. Insects that attack modern ponderosa pine and Douglas-fir were not observed at Mesa Verde, but the scoring was by species of insects that commonly attack these trees in other places.

The examination of timbers indicates that most trees were barked during July or very early August. Wood cut during the autumn, winter, or early spring is attacked by bark beetles and borers the following summer. By late July or August the phloem-wood borers enter the wood and thereafter feed only upon wood. After a year or longer they emerge as adults, cutting a characteristic exit hole. Only a very few of the 95 timbers examined showed either the entrance or exit holes of these insects. This proves that the bark was removed during July or early August while the larvae of the phloem-wood borers were still mining between the bark and wood.

#### Seasonal Schedule of the Indians

The evidence described in the preceding paragraphs and the distribution and occurrence of axe marks on the timbers indicate that in their logging practices the Indians followed a relatively definite schedule. Most of the timbers showed axe marks only at points where branches had been cut off. This was true of 88 of the 95 pieces. Only 11 beams showed axe marks at other places. On six, patches of bark had been chipped away. On two, one side of the piece had been barked with the axe. Three pieces had axe marks visible over the

entire timber. Three, which were cankered and apparently dead when cut, were only partly barked. Only one timber had been left entirely unbarked. Clearly the Indians removed the bark from almost all timbers before using them.

From our observations of structural timbers we conclude that the Indians used whatever timbers were available; old timber, occasionally a broken branch, rarely dead trees, and when new timbers were cut they were usually from living trees.

Nichols reports that a large proportion of the structural timbers were cut during the period of spring growth as indicated by the presence of an incomplete outer ring. Based on a sample of 167 specimens he found that only 52, or approximately 30 percent had complete outer rings. These would be trees that were cut after the end of the growing season. The remaining 70 percent were cut during the growing season in spring or early summer.

Although infestation of freshly cut logs may occur throughout the summer, the attacks are mostly concentrated in June and July. By August attacks would be sporadic for most species.

After a tree is cut a week or more usually elapses before it becomes suitable for attack. The length of this period will vary with temperature and rainfall, but will be materially shortened if the top is left on the tree after it is cut. A tree cut in fall or winter will usually still be suitable for attack the following spring.

From our observations of timber combined with what is known about the insects that attack freshly cut wood, we conclude that a relatively small proportion, perhaps one-third, of the Indian's timbers were cut during the dormant season. Perhaps two-thirds was cut during the spring or very early summer when diameter growth is most rapid. Apparently felled trees were left untouched until late July or very early August. During that period insects would have loosened the bark so that it could easily be stripped off. Thus the Indians very wisely took advantage of the phloem eaters as debarking agents.

#### CONCLUSIONS

This paper summarizes the results of a preliminary study of the remains of insects and their work that were recovered from ancient Indian structures on Wetherill Mesa. The field work was done during the season of 1961 and during a short period in 1962. Following the washing technique developed in 1961, insect remains were collected from samples taken from Step House during its excavation. This series was more representative than the samples from Long House and Mug House.

The fragility of the insects necessitated that a special procedure for preserving them for study be used. The insects or insect parts were cemented to glass slides, using alvar, an alcohol soluble plastic. Thus they could be examined without handling them.

Several potential pests of stored grain were recovered from the ruins. However, very little evidence of insect work was found in grain taken from the sites. In all probability infested grain may have been reduced completely to an unrecognizable state during the centuries since A.D. 1300.

A very large proportion of the insects recovered from the ruins might be classed as household pests and scavengers. In many respects these were similar to the insects that plague the modern housewife in her kitchen. An undescribed ptinid beetle, a species of Niptus, was most common. Dermestid beetles were also numerous especially those belonging to the carpet beetle group. Larder beetles were less frequently recovered. These beetles are particularly destructive to animal products but by no means restrict their feeding to such things. Other insects that must have been present in the Indian dwellings were not found in our samples; for example human parasites and parasitic bugs commonly associated with pack rat nests.

The scavenger insects, mostly beetles and flies, were associated with burials and fecal materials of humans and turkeys. They were the kinds that would be found today with such materials. The presence of fly puparia in a burial provides evidence that the individual died during warm weather.

Several potential pests of crops were recovered from the ruins. False wireworms belonging to the genus Eliodes were especially common. These insects are pests of modern grain fields in localities where the climate is dry. A large scarabaeid beetle

that feeds on plant roots in the larval stage is another potential pest found both in the ruins and living on the mesa.

The presence of dead beetles of this root eating species trapped beneath the adobe floor of a repaired kiva in Long House indicated that the kiva may have been abandoned for many years before the floor that trapped the beetles was laid. This find raises a question. Was part of Long House abandoned while other parts remained in use or was the entire cave abandoned and later reoccupied? Were the Indians, because of pest outbreaks characteristic of field crops, forced to move periodically from the old to new fields?

Almost all structural timbers showed marks on the wood surface made by bark beetles and borers. The character of this work indicates that the Indians took advantage of the work of these insects for loosening the bark of felled trees. The trees were cut in late fall, winter, or early spring. Later in July or early August, after the bark had been loosened it was removed.

From our studies of insects on Wetherill Mesa we conclude that the remains of insects and their work can provide archaeologists with information that will be useful in their research, and that this source of material should not be disregarded.

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