# Monitoring and Long-Term Control of Insect Pests at Colter Bay Indian Arts Museum, Grand Teton National Park, 2005

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**Completion Report by C. Brian Villalobos**
Grand Teton National Park
Division of Science and Resource Management
P. O. Drawer 170
Moose, WY 83012
307-739-3483
E-mail: charles_villalobos@nps.gov

In Partnership with the University of Wyoming
Dr. Alex Latchininsky, Principal Investigator

## Introduction

The Colter Bay Visitor Center and Indian Arts Museum displays the David T. Vernon Collection that consists of Indian pottery, clothing, moccasins, tools, weaponry, papers, and other artifacts. The collection was appraised at more than $6.2 million. Protection of this valuable, unique, and irreplaceable cultural resource is paramount. An historical baseline survey at selected Museum collection areas revealed pest and nuisance insect infestations (Latchininsky et al. 2004, RM-CESU Final Report). Most notably, numerous booklice and carpet beetles that can damage Museum artifacts were identified.

*Goals and Objectives:*

1. Conduct comprehensive monitoring of insects in the Museum
2. Identify and enumerate insects on sticky traps and add insect records into Park collection
3. Improve protection of the David T. Vernon Collection of Indian Arts
4. Implement Integrated Pest Management (IPM) recommendations for long-term control of insect pests that damage museum collections.

## Methods

*Insect monitoring within the Museum:* According to Latchininsky et al. (2004), sticky card traps are passive traps that capture insects with a sticky adhesive coating applied to one side of card stock paper. This sticky surface traps insects and other small arthropods that crawl on it. Sticky traps can remain in place for a long time and are a good way to monitor for the presence of insect pests. One-hundred six TRAPPER monitor and insect traps were strategically placed within exhibits, storage areas, visitor areas, offices, and the infrastructure of the Museum. The traps were collected from the Museum once each month from April through October of 2005 and sent to the University of Wyoming for identification.

*Insect ID, enumerate insects on sticky traps, and add pest records into Park collection:* Insects collected on sticky traps were sent to the University of Wyoming, Cooperative Extension Service Insect Diagnostic Laboratory for identification. Identification and enumeration were done with a microscopic examination, taxonomic keys, and reference specimens from the University of Wyoming Insect Museum collection (Latchininsky et al. 2004). Park GIS personnel created an ACCESS Database to input, link, query, report, and add insect data from Museum sticky traps into the Park's Inventory and Monitoring database.

**Results and Discussion**

During the 22,684 sticky-trap nights sampled within the Museum, 4,724 individuals were trapped during this seven month study. Sixty-one species of arthropods from 58 families and 15 orders were trapped (Table 1). Six of 15 orders i.e., Collembola (springtails), Diptera (flies, gnats, mosquitoes), Psocoptera (booklice), Hymenoptera (ants, wasps), Aranea (spiders), and Coleoptera (beetles), account for 4,606 individuals or about 97.5% of the total trapped.

Springtails account for 2,284 individuals or about 48.3% of the total trapped. They are nuisance building invaders associated with soil and houseplants, feed on decaying organic matter, help recycle nutrients in the natural ecosystem, and are harmless to humans and Museum collections. Rarely, they enter buildings seeking shelter or areas of higher humidity, however these invasions are often short-lived. They either disperse back to the soil or die in the aridity of the building. According to trapping data, more springtails are trapped in April and May on the inside of exterior museum doors. By the end of June, the number of individuals trapped decreases dramatically, and a few are found within exhibits closest to their access points.

Dipterans account for 1,054 individuals or about 22.3% of the total trapped. Of those trapped, the fungus gnat, humpbacked fly, moth or drain fly, and the muscid or house fly account for 856 individuals or about 81.2% of the total Dipterans trapped. These ubiquitous species were trapped in relatively low (<5/trap) and consistent numbers throughout the sampling period. They enter through open doors, gaps between double-doors, and open windows without screens. More Dipterans were trapped within the Museum in late summer and early fall when outside ambient temperatures decreased. Although some of these species are potentially hazardous to human health, they do not pose a threat to the Museum collections. Latchininsky et al. (2004) discusses these pest and nuisance species and recommends IPM treatments that emphasize sanitation through improved housekeeping and other pertinent treatments.

Booklice account for 533 individuals or about 11.3% of the total trapped. Booklice are Museum pest species that require high humidity, feed on molds, starchy bindings and pages of books, and are located in warm, dark, moist areas of the Museum. These species were trapped predominately in the lower level of the Museum. Initially, numerous booklice were trapped within 10m of the boiler room and in the Basket and Medicine Room exhibits that are within 25m of the boiler room. As summer and fall seasons progress, the number of booklice trapped decreased then remained steady, and booklice were trapped in different adjacent locations. They expand their range or disperse within the Museum. This species of booklice may be self-perpetuating within the Museum, as suggested by only one individual being trapped at an upper level exterior door during the sampling period. Booklice may be "r-strategists," i.e., good colonizers with high reproductive potential, adaptable, invasive, and readily dispersed. Southwood's synoptic model demonstrates the link between habitat stability and relative favorability for pests that have a relative advantage in r-selected habitats. Most pests are r-strategists and are particularly suited to exploiting the ecological patchiness and instability of the Museum as an island ecosystem. Although the environmental conditions of temperature and humidity are controlled in the Museum throughout this sampling period, there exists microclimates that favor mold growth which is a resource used by booklice. Mold, which may grow on the organic artifacts, could be grazed by the booklice and, through time, damage artifacts, but more data are needed. Regardless of the conjecture above, control of booklice involves eliminating moisture sources by improving ventilation and repairing leaks, thereby lowering humidity within the Museum.

Ants and wasps account for 328 individuals or about 6.9% of the total trapped. Ants are very common throughout the Rocky Mountain region and forage for food within the Museum. However, carpenter ants, which are pests, can nest indoors and damage structural wood by excavating galleries. Carpenter ants nest in wood that has softened due to water and decay. Carpenter ant nests or frass were not found inside or on the outside of the Museum. Many different wasps occur in the region and most are highly beneficial predators of pest insects that are fed to their young. Problems with wasps occur when nests are located on

or near buildings or when they enter buildings during the fall in search of overwintering shelter. Few wasps enter the Museum and are not considered pests but are, at times, a nuisance species.

Spiders account for 304 individuals or about 6.4% of the total trapped. Scores of spiders are found in the region all of which feed only on insects and other small arthropods. As the top predator in the Museum, they may survive for several weeks or months without food. Most species are attracted to water sources, such as water pipes, floor drains, plumbing fixtures, and air conditioners. Other species prefer warm, dry undisturbed sites and are found in subfloor air vents or upper corners of rooms. Most spiders found indoors hide either in cracks, darkened areas, or silken retreats that they build. These ubiquitous species were trapped in relatively low (<4/trap) and consistent numbers throughout the sampling period. More spiders were trapped per sampling effort after cool weather in late summer and early fall. Presumably, a prey base was also present in sufficient numbers to sustain spider populations within the Museum or they were attracted to the insects in the traps.

Beetles account for 103 individuals or about 2.2% of the total trapped. Of those trapped, dermestid or carpet beetles account for 36 individuals or about 34.9% of the total beetles trapped. Carpet beetles, which are scavengers, are Museum pests that prefer to feed on animal-based products and potentially infest wool, furs, feathers, and hides. Residual populations also may breed on organic debris that collects in or under furniture, around the edge of carpets, or in cracks and crevices. Larvae or immature carpet beetles are active crawlers, do most of the damage to museum collections, and require 60 to 70 days before pupation. Adults are strong fliers and are the dispersal and reproductive stage of the insect. These species were trapped at nine sites in the upper level of the Museum and at five sites in the lower level of the Museum. Trapping records indicate that individuals are entering the Museum through opened doors and unscreened windows. These beetles are persistent in the Museum in low numbers in a few exhibits throughout the sampling period. Alarmingly, many larval individuals were trapped within two exhibits, i.e., Sash (wool) and Tipi (hides) exhibits. These exhibits could be breeding areas. Non-chemical control of carpet beetles includes frequent inspection combined with improved housekeeping and freezing or high temperature treatments of infested artifacts (Latchininsky et al. 2004).

Rodents pose a serious human health threat, may cause physical damage to buildings and artifacts, and attract nuisance and pest insects. They were observed in the Museum basement, and seven traps contained rodent hair or feces. Rodents are a common problem and are found in park buildings that lack effective exclusion. At a minimum, mechanical rodent control requires a thorough inspection of the exterior and interior of the Museum, effective exclusion i.e., rodents must be prevented from entering a building, good sanitation practices that eliminate food, water, and shelter for rodents, continually removing 85 to 95 percent of breeding rodent adults, regularly checking for new rodent activity, cooperation between people with pest management responsibilities and, of course, a basic knowledge of rodent biology and NPS policy. In the Museum's basement boiler room, holes > or = ¼" were sealed and in-take vents were screened. This eliminated rodent activity and reduced arthropod access points by two-thirds in the basement boiler room.

Table 1. Sticky card trap collections from Colter Bay VC and Indian Arts Museum, GRTE, 2005.

| Order | Family | Common_Name (# trapped) |
|---|---|---|
| Acari | Tetranychidae | Spider Mite (3) |
| Acari | Trombidiformes | Mite (5) |
| Aranea | Unknown | Unknown Spider (102) |
| Aranea | Lycosidae | Wolf Spider (1) |
| Aranea | Dictynidae | (Dictynidae) (1) |
| Aranea | Amaurobiidae | (Amaurobiidae) (4) |
| Aranea | Araneidae | Orb Weaver (40) |
| Aranea | Theridiidae | Cobweb Weaver (77) |
| Aranea | Linyphiidae | Sheet Web Weaver (79) |
| Chilopoda | Unknown | Unknown Centipede (1) |
| Coleoptera | Chrysomelidae | Leaf Beetle (2) |
| Coleoptera | Dermestidae | Carpet Beetle (36) |
| Coleoptera | Carabidae | Ground Beetle (17) |
| Coleoptera | Tenebrionidae | Darkling Beetle (1) |
| Coleoptera | Staphylinidae | Rove Beetle (34) |
| Coleoptera | Curculionidae | Snout Beetle (2) |
| Coleoptera | Byrrhidae | Pill Beetle (4) |
| Coleoptera | Anobiidae | Death Watch Beetle (1) |
| Coleoptera | Cantheridae | Soldier Beetle (1) |
| Coleoptera | Elateridae | Click Beetle (2) |
| Coleoptera | Lathridiidae | Minute Brown Scavenger Beetle (3) |
| Collembola | Hypogastruridae | Springtail (Hypogastruridae) (2062) |
| Collembola | Entomobryidae | Springtail (Entomobryidae) (222) |
| Diptera | Mycetophilidae | Fungus Gnat (423) |
| Diptera | Calliphoiridae | Blow Fly (1) |
| Diptera | Pipunculidae | Big-Headed Fly (1) |
| Diptera | Sciomyzidae | Marsh Fly (28) |
| Diptera | Culicidae | Mosquito (11) |
| Diptera | Anthomyzidae | Anthomyzid Fly (12) |
| Diptera | Psychodidae | Moth Fly (134) |
| Diptera | Phoridae | Humpbacked Fly (172) |
| Diptera | Bibionidae | March Fly (16) |
| Diptera | Muscidae | Muscid Fly (127) |
| Diptera | Dixidae | Dixid Midge (2) |
| Diptera | Tipulidae | Crane Fly (4) |
| Diptera | Chironomidae | Midge (116) |
| Diptera | Unknown | Unknown Fly (7) |
| Hemiptera | Reduviidae | Assassin Bug (2) |
| Hemiptera | Unknown | Unknown Plant Bug (1) |
| Hemiptera | Nabidae | Damsel Bug (1) |

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| Order | Family | Common_Name (# trapped) |
|---|---|---|
| Hemiptera | Lygaeidae | Seed Bug (1) |
| Homoptera | Cicadellidae | Leafhopper (2) |
| Homoptera | Aphidae | Aphid (5) |
| Homoptera | Psyllidae | Psyllids (2) |
| Homoptera | Cicadellidae | Plant Hopper (1) |
| Homoptera | Cercopidae | Froghopper (1) |
| Hymenoptera | Braconidae | Parasitoid Wasp (Braconidae) (13) |
| Hymenoptera | Unknown | Unknown Wasp (1) |
| Hymenoptera | Sphecidae | Sphecid Wasp (1) |
| Hymenoptera | Vespidae | Yellow Jacket (1) |
| Hymenoptera | Formicidae | Unknown Ant (273) |
| Hymenoptera | Scelionidae | Scelionid Wasp (1) |
| Hymenoptera | Encyrtidae | Encyrtid Wasp (9) |
| Hymenoptera | Formicidae | Field Ant (5) |
| Hymenoptera | Ichneumonidae | Parasitoid Wasp (Ichneumonidae) (11) |
| Hymenoptera | Formicidae | Carpenter Ant (9) |
| Hymenoptera | Perilampidae | Perilampid Wasp (4) |
| Lepidoptera | Noctuidae | Noctuid Moth (3) |
| Lepidoptera | Sesiidae | Clear-Winged Moth (1) |
| Lepidoptera | Unknown | Unknown Moth (2) |
| Lepidoptera | Pterophoridae | Plume Moth (63) |
| Orthoptera | Gryllacrididae | Cave Cricket (5) |
| Psocoptera | Liposcelidae | Booklice (533) |
| Siphonaptera | Dolichopsyllidae | Rodent Flea (3) |
| Siphonaptera | Unknown | Unknown Flea (5) |
| Thysanoptera | Thripidae | Thrip (2) |
| Trichoptera | Leptoceridae | Caddisfly (1) |
| Trichoptera | Rhyacophilidae | Primitive Caddisfly (1) |
| Unknown | Unknown | Unknown (0) |
| Unknown | Unknown | Mouse (7) |

**References**

Brewer, M. J., 1994. Insect biology and management resource manual. MP-76. Cooperative Extension Service, Department of Plant, Soil, and Insect Sciences, College of Agriculture, University of Wyoming. 25 pp.

Crenshaw, W., S. Armburst, M. Brewer, and S. Lajeunesse. 1994. Household insects of the Rocky Mountain states. Bulletin 557A. Colorado State, University Cooperative Extension. 90 pp.

Hoddenbach, G., J. Johnson, C. Disalvo. 1997. Mechanical rodent proofing techniques. National Park Service, Public Health Program, Washington, D. C. 54 pp.

Latchininsky, A., S. Schell, S. Schell, and L. Oestman. 2004. Survey and mitigate for effects of swallow nests at Colter Bay Visitor Center and Indian Arts Museum, Grand Teton National Park. RM-CESU, NPS. 8 pp.

Radcliffe, E. B. 2000. Radcliffe's IPM World Textbook: Introduction to Population Ecology. Department of Entomology, University of Minnesota. http://ipmworld.umn.edu/chapters/ecology.htm

**Project Follow-up**

We will create an IPM plan, exclude pests at all GRTE facilities housing Museum collections, and insect sticky-trap monitoring will continue indefinitely. We would like to use this study as a catalyst for a future publication.