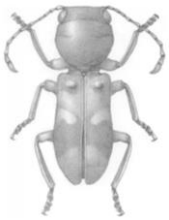

Barriella longicornoides Opitz

WILLIAM F. BARR ENTOMOLOGICAL MUSEUM
TECHNICAL REPORT No. 1

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University of Idaho

Insects of the riparian zone of the Wild River section of Hells Canyon National Recreation Area, Idaho

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ABSTRACT

Insects at three alluvial sites in the Wild River section of Hells Canyon National Recreation Area of the Snake River, Idaho, were surveyed during 1990–1992. A total of 350 species of insects representing 7 orders and 55 families were collected and identified. Of these, 276 species were moths collected in flight at UV light. Other terrestrial insects were collected by hand picking, aspirating, aerial net, beating onto a sheet, rearing from infested wood, and by pitfall traps. Several new state and host records were obtained. This information provides an original contribution of information characterizing a unique and unstudied area to the Idaho Insect Survey. It will also provide a base in time for future surveys and studies of the ecological state of this unique, isolated area as influenced by changes in climate and human visitation.

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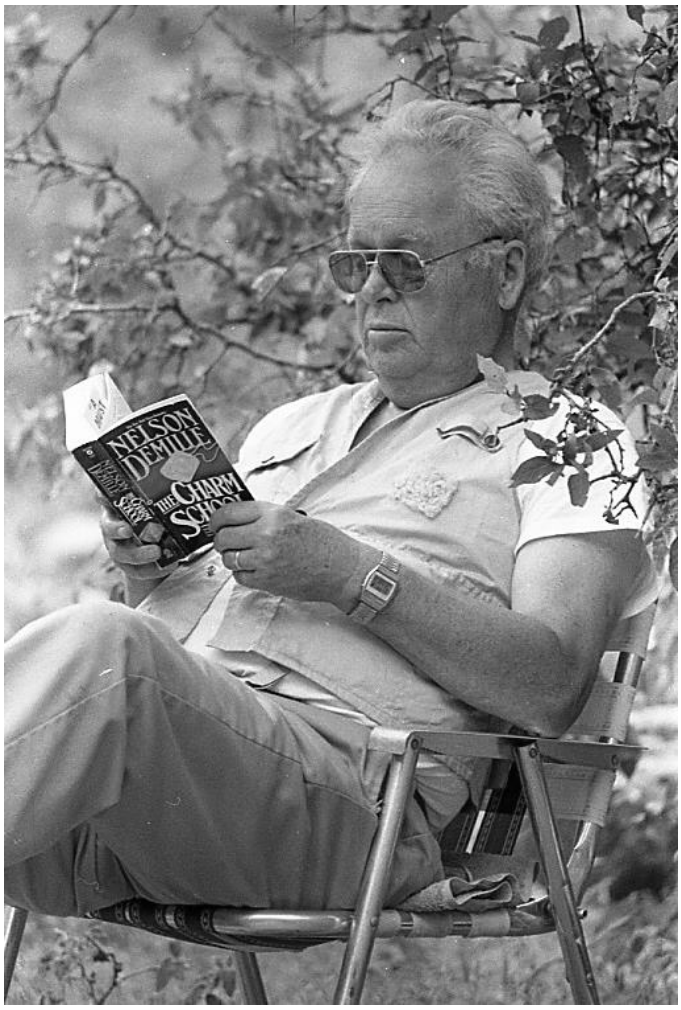
DEDICATION

William F. Barr (1920–2011) contributed more than anyone to the knowledge of Idaho's insect fauna. His enthusiasm for collecting insects in their natural settings never diminished. During June 1990, at age 70, he camped with us at the Sheep Creek site. Immediately, Bill was pointing out insects of note. First it was a buprestid, *Acmoeadera idahoensis* Barr, on a flower of shaggy fleabane. He suggested that its larval host was hackberry, common along the river. Wherever he went, something was discovered, such as the abundance of an earwig that he noted had unusual white spots and a reddish head. He had specialized in taxonomy of the predacious Cleridae beetles. Before long, his beating of hackberry dislodged a showy clerid, *Trichodes ornatus* Say, and a cerambycid that he thought might be its prey. My (MMF) own broad interests have been shaped by his tutelage but, for this trip, I focused on insects infesting bark and wood of trees along the river. Sure enough, my first encounter was a stag beetle (*Sinodendron rugosum* Mannerheim) that I had never seen alive but of which Bill had reported the first Idaho record. Our time together in this isolated canyon lingers in memory and we are pleased to dedicate this publication to our mentor and colleague.



INTRODUCTION

Over eons of time, the Snake River has carved a great canyon separating the Seven Devils Mountains of western Idaho and the Wallowa Mountains of northeastern Oregon. Measured from mountaintop to river, this precipitous canyon is nearly 8,000 feet deep, exceeding even the Grand Canyon. The area became known as Hells Canyon due to the turbulent rapids encountered by boatmen. Much of the area adjacent to the river is steep and rocky (Fig. 1 A–B) except for benches (Fig. 1 C) created by prehistoric Lake Bonneville flood deposits (Alt and Hydman 1995) and alluvial outflows from side streams where more diverse vegetation has become established. Many of these plants are native, including bartonberry, *Rubus bartonianus* M. Peck, (Fig. 2A), which is found mainly there, and some are so rare as to be of species of concern (e.g., MacFarlane's four-o'clock, *Mirabilis macfarlanei* Constance and Rollins). Other, non-native, plants were propagated purposely by homesteaders who came to the area beginning in the latter part of the 19th century. Still other plants (and insects) may have come from elsewhere, possibly by river currents and perhaps unintentionally by the growing numbers of visitors since the area was designated as Hells Canyon National Recreation Area (HCNRA) in 1975.

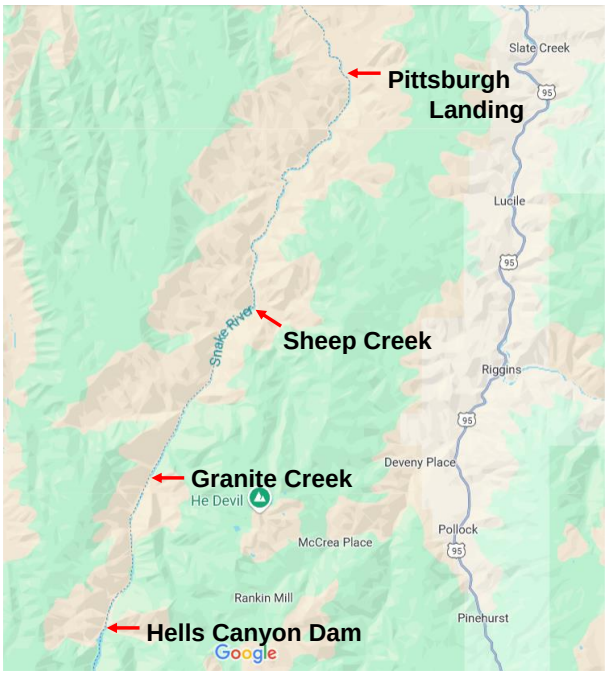
Historically, the areas involved in this survey have seen homesteading (Fig. 2B) and intense grazing by sheep and cattle (Carrey et al. 1979). Since establishment of the HCNRA, however, such uses of the river corridor have been phased out or reduced. In their place, thousands of recreationists visit the area in summer, many by jet boats and rafts, while others come on foot. This transition of use has set underway further changes in the make-up and condition of the vegetation and thereby the kind and abundance of associated insects.

The plants of the Wild River section of HCNRA have been the subject of study (e.g., Bingham and Henderson 1978, Yates 2007). However, the insects of this area have not been investigated except for a brief survey of aquatic insects in the vicinity of Pittsburgh Landing (Brusven and MacPhee 1974). We present here results of an exploratory survey of insects at three alluvial sites in the Wild River section of HCNRA during 1990–1992. Our intent is to establish a reference base of the diversity of insects that are present in this river influence zone; to focus on species of particular interest to science, and to promote further surveys and studies that may provide useful indicators of the ecological state of this isolated area through time as influenced by climate change. Pinned and ethanol-preserved specimens from our collections are deposited in the W.F. Barr Entomological Museum (WFBM), University of Idaho, Moscow, Idaho. Label data of many of the preserved voucher specimens has been digitized, and data is available online [https://ecdysis.org/].

DESCRIPTION OF SURVEY AREAS

Three locations on the Idaho side of the Wild River section of HCNRA were surveyed. The history of settlement and ranching in the canyon, including these areas, is detailed by Carrey et al. (1979). Bingham and Henderson (1978) list 100 of the most common plants of this Wild River section including the specific sites of our survey. We only mention those involved as hosts of some insects of special interest; however, this 1978 reference will be relevant to any future study of insect-host associations and changes in their make-up over time.

Lower Pittsburg Landing (PL), 34 miles below Hells Canyon Dam, Approximate elev. 1160 ft. This is the northern boundary of the Wild River section of Hells Canyon. The area consists of a broad flat composed of Bonneville deposit through which Kurry Creek drains into the Snake River. Native Americans frequented the area in prehistoric time as evidenced by petroglyphs that remain. The area was homesteaded in the late 1880s and the vegetation was heavily impacted by subsequent grazing by sheep and cattle. Due in part to its sun-exposed terrain, vegetation of this area is less diverse than at the other sites. Insects were collected at UV light on the Idaho side except for one evening, 9 May, 1990, across the river in Oregon at the U.S. Forest Service administrative site. Dates of collections were 1990: 9–10 May and 7 June; 1991: 1–2 July; 1992: 16–17 May, 23 June, and 15 July.



Sheep Creek (SC), 19.5 miles below the dam, approximate elev. 1300 ft. The survey was centered here. Visitors get there by boat or by trail from end of a dirt road from Whitebird. Foot and horseback travelers will encounter precipitous Suicide Point along the way (Fig. 1B). The area was homesteaded in 1884 and has been occupied since then. At the time of our survey, the old cabin (Fig. 2B) was leased and is the southern-most destination of popular jet-boat excursions from Lewiston, Idaho. Due mainly to the favorable site, but also to plantings of exotics by earlier occupants, plant diversity was greater here including the rare bartonberry that grows nearby. Collecting extended up Sheep Creek for 1/2 mile. Dates of collections were: 1990: 9–12 May, 7–10 June, 5–8 July; and 1991: 29 May–1 June.

Granite Creek (GC), 9.5 miles below the dam, approximate elev. 1960 ft. To reach this remote area from either direction requires traversing challenging Class IV rapids. Granite Creek was homesteaded in 1902. A gripping account of the lives and fate of the first inhabitants, Earl Hibbs and his wife, Ellen, is given in Carrey et al. (1979). The "Hibbs ranch" was located about one mile up Granite Creek and that vicinity was included in our survey. There, the woody vegetation was particularly diverse. We were able to collect at remote Granite Creek only once, during 16–18 May, 1992.

SURVEY METHODS

Collecting methods consisted of aspirating (Fig. 2C) and hand picking, using a sweep net and beating sheet (Fig. 2D), maintaining ultraviolet (UV) light at night (Fig. 3A), caging infested stem wood for insect emergence, and pit-fall trapping (Fig. 3B). Each method was suited to collecting particular insects depending upon their environment and behavior. Moths caught at UV light were pinned and spread in the field during the following mornings. A Schmitt box was modified for this purpose (Fig. 3C). This procedure had the advantage of making known what was being collected, and protected the condition of specimens of this important and large component of the insect fauna of HCNRA.

RESULTS AND DISCUSSION

A total of 350 species of insects representing 7 orders and 55 families were collected. Taxonomy in use at the time of the survey is retained herein to facilitate future comparison. Changes have already occurred with Arctiidae, Lymantriidae and many Noctuidae being transferred to Erebidae and Pyralidae partly transferred to Crambidae in recent years. Of these, 276 species were moths collected at UV light (Tables 1 and 2). Insects other than moths are listed in Table 3.

We chose to base the survey at Sheep Creek because it was more central to the Wild River section. Diversity of insects other than moths was generally somewhat greater in June to September and less so in May (Table 3). Moths were markedly more plentiful and diverse during June and early July except for a high catch at Sheep Creek during 9–11 September 1990 (Table 2). Absence of Diptera may be due in part to their elusive flight behavior as well as bias of our collecting methods being unintentionally adapted better to behavior of other taxa. Future sampling of Diptera can be achieved by sight-collecting and the use of Malaise traps, pan traps and baited traps.

Baseline data generated in this survey will be of value in planning future surveys and studies of individual species encountered and for monitoring changes among this fauna over time. This information furthers an understanding of the biodiversity of the area and forms a baseline for

future research. In that vein, we mention here examples of insects encountered by the survey that are of particular scientific interest.

Moth species attracted to UV light at night

A total of 276 species of moths, representing 24 families were curated (Tables 1 and 2). Although there may have been some unintentional bias in selecting attracted moths of best condition for retention and identification, the relative abundance of all attracted species appeared to be the same as those curated. The dominant families were: Noctuidae (26%), Geometridae (23%), Pyralidae (20%), and Tortricidae (10%). However, only one Gelechiidae, *Metzneria lappella* (Linn.), was collected eventhough this family is one of the larger ones countrywide. *Metzneria lappella* infests seed heads of burdock along rivers; the annoying burrs stick to animal fur and clothing. The remaining 21% of species caught at UV light were spread over 19 other families.

Carpenterworm

The carpenterworm, *Prionoxystus robiniae* (Peck) (Cossidae) infests many hardwoods throughout the United States and southern Canada. According to Solomon (1995), cottonwood (*Populus* spp.) and elm (*Ulmus* spp.) are favored hosts in the northwestern states and Rocky Mountains. We report the first record of its occurrence in Idaho (Sheep Creek), feeding on white alder (*Alnus rhombifolia* Nutt.) and birch (*Betula occidentalis* Hook.). Larvae (Fig. 4A) of this moth infest the stems of living trees and develop large tunnels that enter the wood and turn upward for several inches. Pupation occurs at the tunnel entrance from where the pupal case remains (Fig. 4B) after emergence of the adult stage. The female (Fig. 4C) is protectively marked; its mottled grey and black scales blend with bark. Her body is distended with hundreds of eggs and some are deposited before she can fly. During this pre-flight period, we observed that females actively vibrated their wings, possibly to disperse male attractant pheromone. Moths began emerging from caged stems on June 20, 1991. At Sheep Creek, a moth came to UV light on July 1st, 1991. Infestation does not kill the host tree but may weaken the trunk. Other insects, including ants, utilize and extend the tunnels after they are vacated.

Leaf miner on poison ivy

Another moth of interest is a gracillariid leaf miner, *Lithocolletis guttifinitella* Clemens (Gracillariidae), whose larvae were found feeding on foliage of poison ivy (*Toxidodendron* sp.) at Sheep Creek. River visitors would be cheering but the damage was much less than that described elsewhere by Frost and Tothill (1928): "It makes broad, tortuous, whitish, upper surface mines, which take on shapes as varied as those of water spilled on a smooth surface. These seem to be spread over almost every leaflet in many ivy patches in early autumn; yet the plants appear to be thriving. Several larvae are at work together in nearly every mine. When one sees how very abundant they can be in this noxious plant, it seems almost a pity that their methods of feeding injure that plant so little." If the larvae are found to detoxify urushiol, the compound that is poisonous to humans, it would be of potential medical interest.

Polyphemus moth

The Polyphemus moth, *Antheraea polyphemus* (Cramer), (Fig. 5A) was reared from a cocoon collected at Sheep Creek on 11 May, 1990. Though never abundant, this beautiful moth would be greatly admired by those river visitors fortunate enough to observe it. They should be encouraged to photograph it and report sightings of it, and any other observed insect, on iNaturalist, and to leave it unmolested in tribute to the wild environment that attracted them to come here.

The annoying "miller"

We asked administrative personnel: "What comments have you had from the public concerning insects that they have encountered?" We expected to hear that they were bothered by mosquitoes or yellow jackets. Instead, what they described as a "miller" (resembling a small moth) was bothersome to campers at night around lights. This "miller" turned out to be a small (1 cm long) caddisfly, *Cheumatopsyche arizonensis* (Ling) (Hydropsychidae) (Fig. 5B). In evenings of 5–7 July, 1990, so many of this caddisfly came to the illuminated bag

enshrouding the UV light, that moths were prevented from arresting there and their abundance interfered with our breathing. This aquatic insect prefers a rapid current, such as Sheep Creek might provide, where it spins a cup-shaped net to catch drifting materials on which it feeds. It is known from southwestern states, Utah and Wyoming: this is the first Idaho record.

Gall makers on netleaf hackberry

Netleaf hackberry, *Celtis reticulata* Torr. is a medium-size multiple-trunked shrub or tree, rather scraggly in appearance due to its erratic branching habit. It occurs in the west, most extensively in Texas, parts of New Mexico and Arizona, and in northern Mexico (Fig. 5C); disjunct populations occur northward to the Snake and Columbia Rivers. In Idaho, its leaves and twigs are commonly deformed by galls resulting from infestation by psyllids of the genus *Pachypsylla*. At Sheep Creek, we collected *P. celtidisgemma* Riley and *P. celtidismamma* (Fletcher) by beating branches (Fig. 2D). This is a new distribution record for both species, there being no mention of them from Idaho in references such as Hodkinson (1988) and Tuthill (1943). Those sources give the following distributions: *P. celtidismamma*: Ontario, Canada; eastern USA westward to Arizona and Utah; *P. celtidisgemma*: Eastern USA, west to Texas. Host: *Celtis occidentalis* L. (*C. reticulata* not listed). A third species, possibly an inquiline, remains un-identified. A fourth species, *P. venusta* (Osten Sacken), was collected from hackberry galls at Johnson Bar [near Sheep Creek] by F.D. Johnson, 20 May 1977.

We collected adult *Pachypsylla* specimens by beating branches but did not focus on morphological differences in galls that were present. However, according to Tuthill (1943), the feeding by *P. celtidismamma* nymphs on the underside of new leaves in spring causes the leaf tissue to expand rapidly into a pouch-like gall around the insect. This species, like the others, is univoltine. The nymphs exit galls in autumn, then transform to adults that overwinter in bark crevices. The gall is monothalamous, having the nymphs contained in a single chamber. *Pachopsylla celtidisgemma* overwinters as a nymph inside the gall, which was formed from the axillary buds on the twigs. It is polythalmous, having each nymph in a separate chamber.

After the survey, we investigated the galls present down river from HCNRA in the vicinity of Lewiston, Idaho. There, *P. venusta* is the dominant if not the only species. This species creates a persistent, polythamous, gall on the petiole, which envelops the base of the leaf (Fig. 6A). The galls vary in size from 1.0 – 1.5 cm. They are not completely closed on the upper side, creating two halves joined at the bottom. Larger galls typically contain 4 nymphs (two per half); smaller galls have fewer nymphs. Overwintering nymphs are about 4.3 mm long; their chambers are lined with smooth white secreted wax (Fig. 6B). The galls are very hard (woody); however, at least one of the nymphal chambers of each half of a gall has a thin interior wall that is ruptured by use of a sclerotized, spine-like extension of the posterior of each nymph. From above, this extension is blunt, slightly tapered, and shallowly dished at its terminus. Viewed obliquely from the side, the spine has two very short blade-like ends. Its base is well supported by a broad, black, heavily sclerotized foundation on which are several sharply pointed spines surrounding the larger central spine. These sharp spines probably aid in tearing away the interior wall of the gall. The nymph inhabiting the ruptured chamber emerges there; other nymphs rupture the membranes between adjacent nymphs, forming a common chamber, thereby enabling all in that half to use one exit point. Once free, the nymphs transform to adults, which oviposit on developing leaves to begin a new generation.

Bark beetles and ambrosia beetles

Five species of Scolytinae were collected at Sheep Creek. Two are bark beetles that are native to Idaho (Furniss and Johnson 2002): *Pseudips mexicanus* (Hopkins), from ponderosa pine, *Pinus ponderosa* Laws., and *Alniphagus aspericollis* (LeConte) from white alder. Three others came to the United States long ago from Europe and are established extensively in Idaho. They are a bark beetle, *Scolytus rugulosus* (Müller), in *Prunus* and *Amelanchier*, and two ambrosia beetles, (*Xyloborus dispar* (Fabricius) and *Xyleborinus saxesoni* (Ratzeburg)) taken in flight but known to infest alder and birch. Ambrosia beetles invade the sapwood of distressed and dying

trees where their progeny feed on symbiotic yeast fungi transmitted by their parents.

Stag beetle

A lucanid stag beetle, *Sinodendron rugosum* Mann., (Fig. 6C) was reared from decaying wood in the base of an Alder at Sheep Creek. The male has a hornlike protrusion on the head, which is thought to be used in combat with other males. Barr (1957) reported the first Idaho records (Nez Perce and Twin Falls Co.); it is now known from six counties, this being the first record from Idaho County.

Ant

An ant, *Hypoponera* prob. *punctatissima* (Roger), was caught in a pitfall trap at Sheep Creek. Ants in the genus *Hypoponera* are small, mostly subterranean, insects that are more common and diverse in the tropics. Many are rather similar in appearance, and the males and queens often resemble workers. Despite the abundance of these ants, little is known about their biology. No *Hypoponera* species is known from Idaho (Yensen et al. 1977) although four species occur in California, of which two are apparently introduced. The collection of only two specimens leaves their establishment in HCNRA still uncertain. They could have been carried there just recently by the influx of summer visitors from areas known to have *Hypoponera* species. It should be looked-for in future surveys along with other insect species that may be making their way northward.

ACKNOWLEDGMENTS

This publication is dedicated to our mentor and colleague, William F. Barr (1920–2011), who contributed more than anyone to the knowledge of Idaho's insect fauna. The impetus for this survey stemmed from a collection record of an undescribed new species of *Orthonama* (Lepidoptera: Geometridae), from Johnson Bar by J.F. Gates Clarke in 1926. D.C. Ferguson (deceased), U.S. National Museum, Washington, DC, sought more specimens in anticipation of naming it, which led to our becoming interested in a general survey. We collected only one specimen of *Orthonama* sp., the identity of which is still uncertain. Don Davis, Smithsonian Institution, Washington, DC, confirmed that the Johnson Bar *Orthonama* specimens are there and that they were not described. Mike Cole, Ranger, HCNRA, provided boat transportation. William F. Barr and Terry Miller, Division of Entomology, University of Idaho, Moscow, assisted with collecting at Sheep Creek. Ron Leuschner, Los Angeles County Museum of Natural History, identified many of the Lepidoptera listed in Table 1. Jon Sheppard, Nelson, B.C, Canada, also examined many of the Lepidoptera including all of the Noctuidae, Sphingidae and Geometridae. Jerry A. Powell, University of California, Berkeley, identified *Anoncia leucoritis.* Michael D. Schwartz, Ottawa, Canada, identified Miridae; Aurthur J. Gilbert, Fresno, CA, identified Chrysomelidae; John Pfeiffer and Pat Barrett, EcoAnalysts, Inc., Moscow, ID, identified *Cheumatopsyche arizonensis*. Richard Westcott, Oregon Department of Agriculture, Salem, OR, identified the Buprestidae. Psyllidae were identified by Douglass R. Miller, USDA Systematic Entomology Laboratory, Washington, D.C. Other insects were identified by us. Gene Yates, Botanist, Wallow-Whitman National Forest, Baker City, OR, identified plants and provided information on their distribution. The manuscript was reviewed by Sandra J. Kegley, retired Forest Entomologist, USDA Forest Service, Coeur d'Alene, William H. Clark, The College of Idaho, Caldwell, and by James B. Johnson, Division of Entomology, University of Idaho, who also identified the Neuroptera and Raphidioidea. This work was part of the state-funded Idaho Insect Survey.

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Fig. 1A–C. The topography of the wild river section of Hells Canyon is steep and often rocky (Figs. 1A–B). Woody vegetation bordering the shore consists mainly of netleaf hackberry, *Celtis reticulata* Torr. Exceptions are several Lake Bonneville flood deposits such as Johnson Bar (Fig. 1C) and alluvial deposits at the mouths of side drainages where the environment favors diverse vegetation and its associated insect fauna. The surveys were located on three alluvial sites.

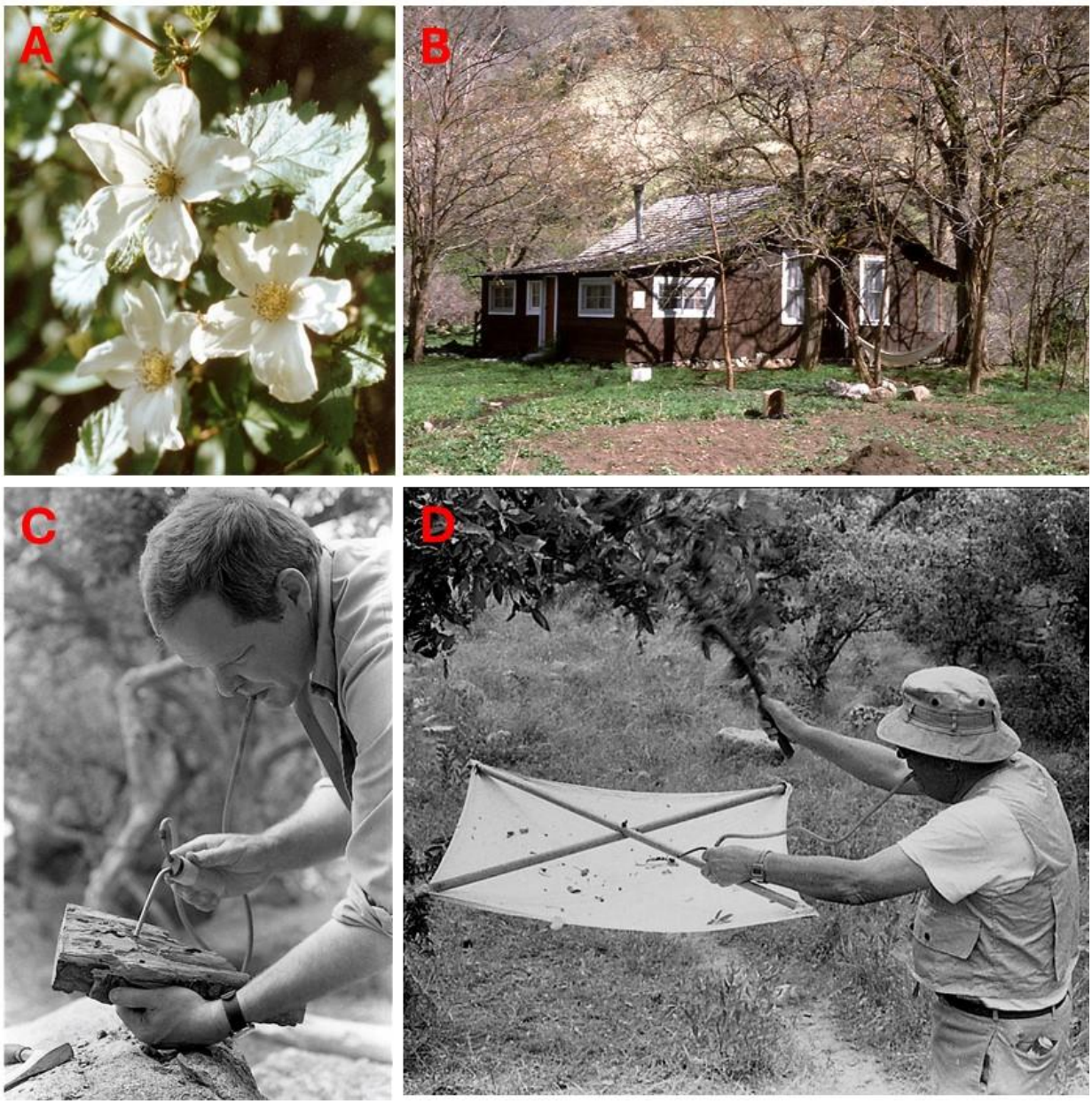

Fig. 2A. Bartonberry, *Rubus bartonianus* M. Peck, was described from Hells Canyon and is restricted in its distribution. We found it in flower near our Sheep Creek base in May 1990.
Fig. 2B. All of the alluvial sites in our survey had been homesteaded beginning in the latter part of the 19th century. This cabin remains at Sheep Creek under lease to an excursion boat company operating from Lewiston, Idaho. Settlers brought with them numerous exotic trees and plants that persist today and are hosts of insects.
Fig. 2C–D. Collecting methods included aspirating (C) and beating branches (D) to dislodge perching insects onto a meter-square canvas cloth as being done here by William Barr at Sheep Creek in June 1990. Barr was a beetle taxonomist at the University of Idaho specializing in the Cleridae and Buprestidae, species of which were collected in this survey. Through his collecting and his many students, the W.F. Barr Entomological Museum, University of Idaho, has become a major resource as repository of insects collected in Idaho.

Fig. 3A. Night-flying moths and other insects such as an abundant caddisfly were attracted to ultra-violet light, where they were caught for curating.
Fig. 3B. Ground-dwelling insects were collected by use of pit-fall traps left between visits. They consisted of pint jars containing diluted antifreeze. The jars were screened to exclude animals other than insects and their opening was set flush with the ground surface and covered loosely with a flat stone to keep out rain.
Fig. 3C. Moths caught in evenings at UV light were pinned and their wings spread the following morning by use of this Schmitt box, modified for the purpose.

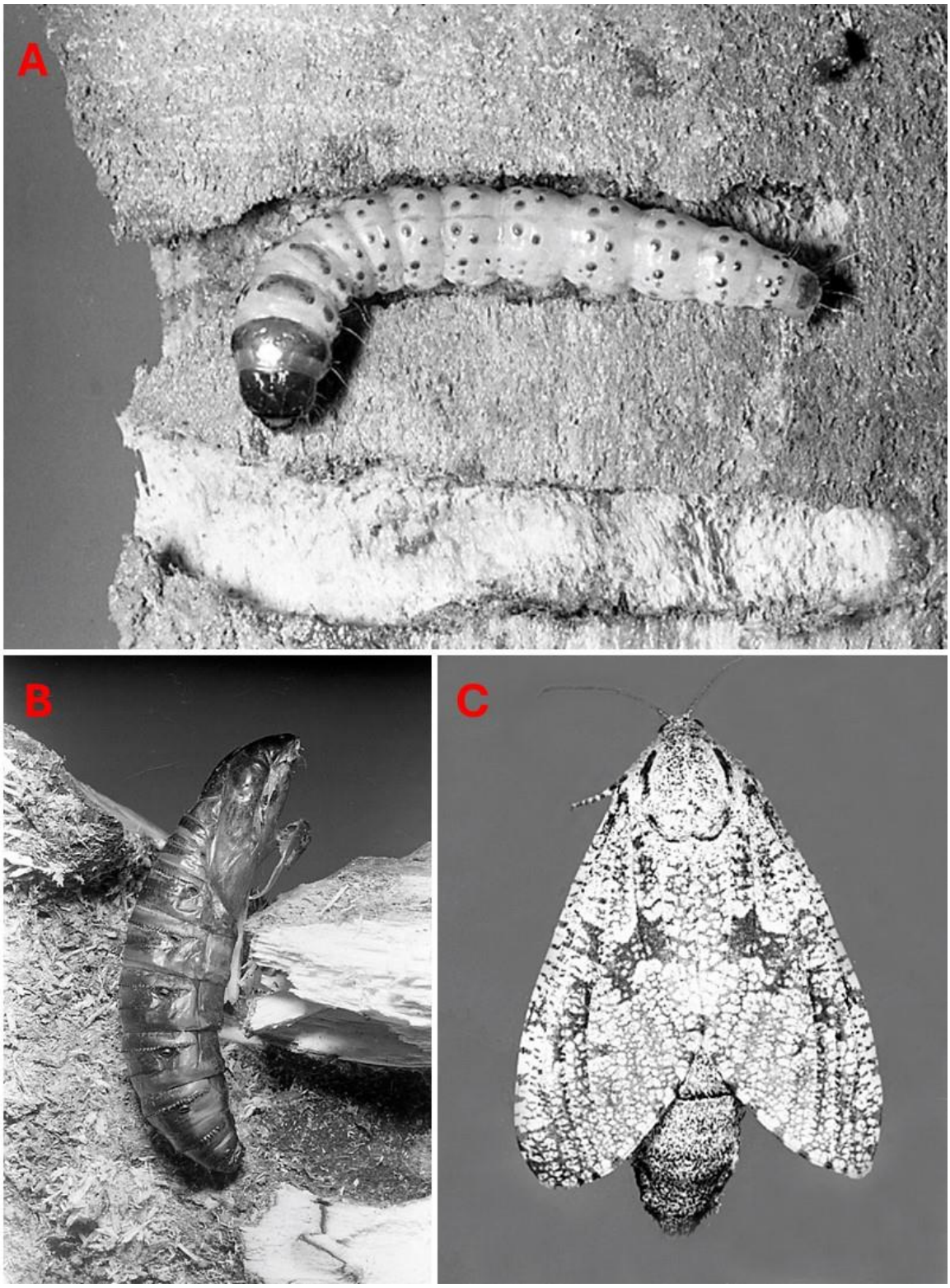

Fig. 4A–C. The carpenterworm, *Prionoxystus robiniae* (Peck) (Cossidae), was reared from alder and birch stems; both are new host records for this insect. A. Larva, B. pupal case protruding from a tunnel entrance after emergence of adult. C. Gravid female immediately after emergence. She cannot fly until some eggs are laid on the bark of the brood tree.

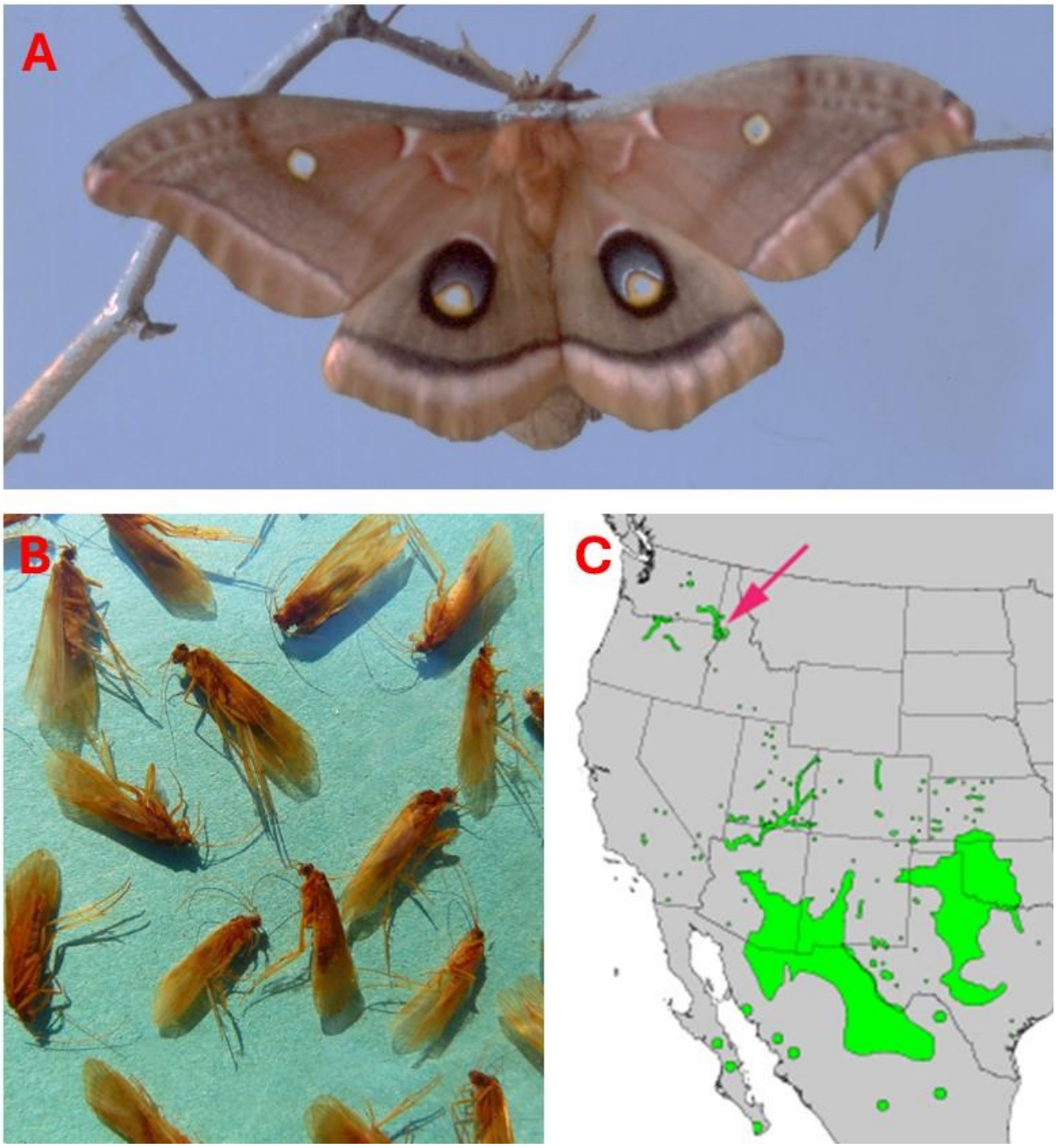

Fig. 5A. This attractive Polyphemus moth, *Antheraea polyphemus* (Cramer) (Saturniidae), was reared from a cocoon on a shrub at Sheep Creek. It occurs on various hosts but not abundantly and is seldom encountered.
Fig. 5B. Large numbers of this small caddisfly, *Cheumatopsyche arizonensis* (Ling) (Trichoptera: Hydropsychidae), annoyed campers who called it a "miller" due to its small size and moth-like appearance. It was attracted to the UV survey light in such numbers that it sometimes prevented moths from landing and even bothered our breathing.
Fig. 5C. Distribution of netleaf hackberry, host of several gall-forming psyllids, *Pachypsylla* spp., including two recorded from Idaho for the first time. Arrow shows the location of the Hells Canyon survey area (after Little 1976).

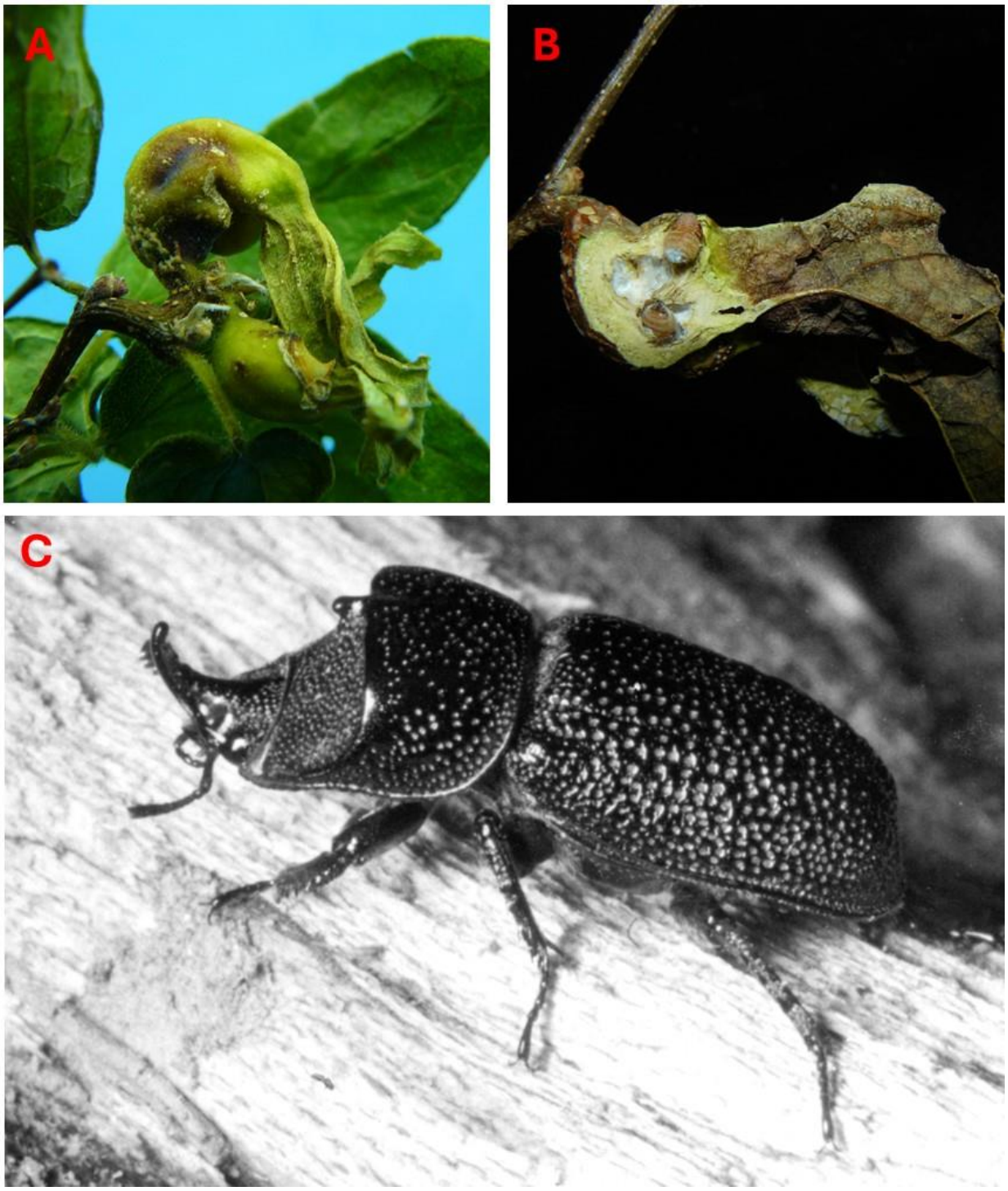

Fig. 6A–B. A. Gall on netleaf hackberry caused by a psyllid, *Pachypsylla venusta* (Fletcher), one of several gall-forming psyllids collected during this survey. **B.** Two mature nymphs and their wax-lined cells exposed by removal of overlying gall tissue.
Fig. 6C. A lucanid stag beetle, *Sinodendron rugosum* Mann., was reared from decaying wood of Alder at Sheep Creek, a first record of its occurrence in Idaho County. The impressive male has a hornlike protrusion on the head evidently used to joust other males.

Table 1 (1 of 10). Moths collected in HCNRA by site and date, 1990–1992. GC is an abbreviation to the Granite Creek site.

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
ARCTIIDAE													
Bruceia pulverina Neumögen										X			
Cisseps fulvicollis (Hübner)					X								
Crambidia casta (Packard)									X	X			
Cycnia tenera Hübner			X										
Estigmene acrea (Drury)			X										
Grammia ornata ornata (Packard)			X					X					
Hyphantria cunea (Drury)											X		
Lophocampa maculata Harris													
Pyrrharctia isabella (Smith)								X			X		
Spilosoma vagans kasloa (Dyar)								X					
ARGYRESTHIIDAE													
Argyresthia goedartella (Linnaeus)										X			
BLASTOBASIDAE													
Unidentified species											X		
CHOREUTIDAE													
Caloreas coloradella (Dyar)													
COCHYLIDAE													
Hysterasia leguminana (Busck) ?					X								
COSMOPTERIGIDAE													
Anoncia leucoritis (Meyrick)			X										
Walshia miscecolorella (Chambers)			X		X								
COSSIDAE													
Prionoxystus robiniae (Peck)			X										
EPIPLEMIDAE													
Callizzia amorata Packard					X								
GELECHIIDAE													
Metzneria lappella (Linnaeus)			X										
GEOMETRIDAE													
Aethalura intertexta fumata (Barnes & McDunnough)											X		
Amphidasis cognataria (Guenée)			X										
Anacamptodes clivinaria clivinaria (Guenée)									X		X		X

Table 1 (2 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Anavitrinella pampinaria pampinaria (Guenée)			X					X	X		X		
Antepirrhoe semiatrata (Hulst)								X		X	X		X
Ceratodalia gueneata Packard									X				
Digrammia californiaria (Packard)			X							X	X		
Digrammia curvata (Grote)			X							X	X		
Digrammia denticulata (Grote)			X						X		X		
Digrammia irrorata (Packard)			X										
Digrammia neptaria (Guenée)					X					X	X		
Digrammia sublacteolata (Hulst)			X										
Digrammia subminiata (Packard)			X										
Digrammia subminiata (Packard)			X										
Digrammia versitata (Pearsall)								X					
Drepanulatrix bifilata (Hulst)													X
Dysstroma truncata (Hufnagel)										X			
Ectropis crepuscularia (Denis & Schiffermüller)			X								X		
Euchlaena mollisaria (Hulst)								X					
Euchlaena tigrinaria sirenaria (Strecker)			X										
Eudrepanulatrix rectifascia (Hulst)													X
Eumacaria madopata (Guenée)			X						X		X		
Eupithecia behrensata Packard			X										
Eupithecia johnstoni McDunnough			X					X			X		
Eupithecia lachrymosa (Hulst)									X				
Eupithecia lafontaineata Bolte								X					
Eupithecia maestosa (Hulst)										X	X		
Eupithecia misturata misturata (Hulst)			X					X	X		X		X
Eupithecia perfusca perfusca (Hulst)												X	X
Eupithecia rindgei McDunnough													X
Eupithecia tenuata Hulst								X			X		
Hesperumia sulphuraria Packard			X										
Horisme intestinata (Guenée)								X		X	X		X
Idaea demissaria (Hubner)			X										
Idaea demissaria ferrugata (Packard)									X				

Table 1 (3 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Iridopsis larvaria (Guenée)			X										
Lambdina fiscellaria lugubrosa (Hulst)										X			
Leptostales rubromarginaria (Packard)					X								X
Lobophora simsata Swett			X										
Macaria aemulataria Walker			X					X		X			X
Metarranthis duaria (Guenée)											X		
Nematocampa limbata (Haworth)					X								
Neoterpes trianguliferata (Packard)									X				
Orthonama centrostrigaria (Wollaston)									X				
Perizoma costiguttata (Hulst)										X	X		X
Pero honestaria (Walker)			X										
Pero mizon Rindge								X					
Pero morrisonaria (Edwards)								X		X			
Pero occidentalis packardi (Cassino & Swett)											X		
Probole amicaria (Herrich-Schäffer)											X		
Protitame subalbaria (Packard)			X						X				
Pterotaea sp.													X
Scopula junnctaria quinquelinearia (Packard)													X
Scopula luteolata (Hulst)	X		X										
Speranza bitactata (Walker)													X
Speranza decorata (Hulst)													X
Speranza lorquinaria (Guenée)								X					
Speranza sulphurea (Packard)			X										
Synaxis cervinaria (Packard)								X			X		
Synchlora aerata liquoraria Guenée			X					X	X	X			X
Triphosa haesitata haesitata (Guenée)										X			
Xanthorhoe defensaria (Guenée)	X		X					X	X	X			X
Zenophleps lignicolorata victoria Taylor										X			
GRACILLARIIDAE													
Caloptilia murtfeldtella (Busck)											X		
Unidentified species			X										
LASIOCAMPIDAE													
Phyllodesma americana (Harris)								X					

Table 1 (4 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
LYMANTRIIDAE													
Orgyia pseudotsugata (McDunnough)										X			
NOCTUIDAE													
Abagrotis crumbi crumbi Franclemont								X	X				
Abagrotis duanca (Smith)								X					
Abagrotis orbis (Grote)			X					X					
Abagrotis reedi Buckett										X			
Achytonix epipaschia nigramacula (Barnes & Benjamin)			X										
Acronicta fragilis minella (Dyar)					X								
Acronicta innotata (Guenée)									X				
Acronicta perdita Grote								X					
Admetovis similaris Barnes								X					
Amphipyra pyramidoides Guenée										X			
Apamea antennata (Smith)					X								
Apamea scoparia Mikkola, Mustelin & Lafontaine									X				
Apamea spaldingi (Smith)											X		
Aseptis binotata (Walker)								X					
Autographa californica (Speyer)							X						
Caenurgia crassiuscula (Haworth)									X				
Caenurgina erechtea (Cramer)			X										
Caradrina meralis (Morrison)								X		X			
Caradrina montana (Bremer)					X								
Catocala junctara Walker													
Cryphia cuerva (Barnes)										X			
Cucullia basipuncta Barnes & McDunnough									X				
Drasteria divergens (Behr)									X				
Drasteria edwardsi (Behr)								X	X				
Drasteria ochracea (Behr)								X	X				
Drasteria sabulosa Edwards									X		X		
Euxoa altens McDunnough									X				
Euxoa atomaris atomaris (Smith)										X			
Euxoa auxiliaris (Grote)								X					

Table 1 (5 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Euxoa bochus (Morrison)													
Euxoa catenula (Grote)										X			
Euxoa divergens (Walker)									X				
Euxoa hollemani (Grote)										X			
Euxoa obeliscoides (Guenée)										X			
Euxoa scotogrammoides McDunnough										X			
Euxoa septentrionalis (Walker)										X			
Euxoa terrenus (Smith)								X					
Feltia jaculifera (Guenée)										X			
Heliothis phloxiphagus Grote & Robinson										X			
Hemeroplanis finitima finitima (Smith)			X		X				X				
Homorthodes discreta (Barnes & McDunnough)										X			
Hypena humuli Harris								X	X	X			
Hyppa contrasta McDunnough					X								
Idia occidentalis (Smith)			X						X	X			
Lacanobia subjuncta eleanora (Barnes & McDunnough)								X					
Lacinipolia stricta tenisca (Smith)										X			
Lasionycta illaudabilis alboguttata (Grote)									X	X			
Leucania insueta heterodoxa Smith								X					
Marathyssa inficita inficita (Walker)			X				X		X				
Melanchra adjuncta (Guenée)					X								
Melipotis jucunda jucunda Hubner								X			X		
Mythimna unipuncta (Haworth)										X			
Nedra dora Clarke										X			
Nedra stewarti (Grote)			X										
Neoligia albirena Troubridge & Lafontaine										X			
Nephelodes minians Guenée										X			
Nycteola cinereana Neumoegen and Dyar													X
Nycteola frigidana britana McDunnough					X			X					
Oligia divesta (Grote)										X			
Oligia fractilinea fractilinea (Grote)								X					
Orthodes delecta Barnes & McDunnough					X								

Table 1 (6 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Orthodes goodelli goodelli (Grote)										X			
Parabagrotis exertistigma (Morrison)					X			X		X	X		
Phobolosia anfracta (Edwards)			X					X		X			
Platyperigea multifera (Walker)			X										
Ponometia semiflava (Guenée)			X										
Ponometia tortricina (Zeller)					X								
Protorthodes curtica bostura (Smith)										X			
Proxenus miranda nitens (Dyar)					X								
Raphia coloradensis Putnam-Cramer			X										
Raphia frater Grote			X										
Spaelotis clandestina (Harris)										X		X	
Spodoptera praefica (Grote)								X	X	X			
Sympistis corusca (Smith)					X								
Xestia c-nigrum (Linnaeus)								X		X	X		
Zosteropoda hirtipes Grote									X				
NOTODONTIDAE													
Datana ministra (Drury)			X		X								
Furcula cinerea (Walker)					X								
Gluphisia septentrionis Walker					X								
Schizura semirufescens (Walker)					X								
Schizura unicornis conspecta (H.Edwards)								X					
OECOPHORIDAE													
Agonopterix canadensis (Busck)											X		
Depressariodes canella (Busck)										X			
Ethmia discostrigella discostrigella (Chambers)			X										
Ethmia marmorea (Walsingham)								X		X			
Ethmia semitenebrella Dyar								X	X				
PLUTELLIDAE													
Plutella interrupta Walsingham			X										
Plutella vanella (Walsingham)					X								

Table 1 (7 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
PTEROPHORIDAE													
Adaina cinerascens (Walsingham)								X					
Capperia ningoris (Walsingham)									X				
Emmelina monodactyla (Linnaeus)									X	X			
Geina periscelidactyla (Fitch)			X										
Geina tenuidactyla (Fitch)					X				X				
Oidaematophorus grisescens Walsingham	X												
Oxyptilus delawaricus (Zeller)					X								
Platyptilia pallidactyla (Haworth)			X										
PYRALIDAE													
Acrobasis tricolorella Grote													X
Agriphila ruricolella (Zeller)			X										
Canarsia ulmiarrosorella (Clemens)					X								
Chalcoela iphitalis (Walker)					X								X
Chrysoteuchia topiaria topiaria (Zeller)			X					X					
Chrysoteuchia topiaria vachellella (Kearfott)			X										
Coenochroa californiella (Ragonot)					X								
Coenochroa illibella (Hulst)			X										
Crambus leachellus (Zincken)									X	X			
Crambus luteolellus luteolellus Clemens									X				
Crambus modestellus Barnes & Benjamin			X										
Crambus zeelus Fernald			X										
Ephestiodes gilvescentella (Ragonot)					X								
Epipaschia zelleri (Grote)								X	X				
Etiella zinckenella (Treitschke)					X								X
Eudonia echo gartrelli (Munroe)				X									
Eudonia leucophthalma leucophthalma (Dyar)										X	X		
Eudonia rectilinea (Zeller)			X					X	X				
Eudonia spenceri (Monroe)					X			X	X				
Evergestis eurekalis Barnes & McDunnough					X								
Evergestis pallidata (Hufnagel)		X								X			
Hahncappsia coloradensis (Grote & Robinson)			X		X								

Table 1 (8 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Homoeosoma stypticellum Grote									X				
Honora mellinella Grote					X								
Hypochalia abietivorella (Grote)													X
Jocara trabalis (Grote)					X								
Laetilia dilatifasciella Neunzig													X
Loxostege sticticalis (Linnaeus)										X			
Manhatta setonella (McDunnough)					X								
Microtheoris ophionalis occidentalis Munroe					X			X	X				
Mutuuraia mysippusalis (Walker)					X								
Myelopsis alatella (Hulst)			X						X				
Nephopterix bifasciella Hulst ?													X
Nephopterix celtidella (Hulst)								X		X			
Nephopterix gilvibasella Hulst													X
Nephopterix inconditella (Ragonot)					X								
Nomophila nearctica Munroe										X			
Oreana unicolorella (Hulst)													X
Ortholepis pasadamia (Dyar)								X	X				
Pediasia aridella edmontella (McDunnough)										X			
Petrophila confusalis (Walker)									X				
Phycitodes albatella mucidella (Ragonot)													X
Pyralis electalis Hulst										X			
Pyrausta fodinalis septentrionicola Munroe									X				
Pyrausta grotei Munroe									X				
Pyrausta subsequalis borealis Packard										X			
Pyrausta unifascialis unifascialis (Packard)			X										
Saucrobotys fumoferalis (Hulst)			X										
Saucrobotys futilalis inconcinnalis (Lederer)			X					X	X				
Scoparia palloralis Dyar											X		
Staudingeria albipenella (Hulst)			X										
Stegea salutalis salutalis (Hulst)					X				X				
Tetralopha callipeplella Hulst											X		
Thaumatopsis pexella gibsonella Kearfott										X			

Table 1 (9 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Udea indistinctalis johnstoni Munroe								X		X			
Udea profundalis (Packard)									X	X			
SESIIDAE													
Synanthedon sequoiae (H.Edwards)								X					
SPHINGIDAE													
Hyles lineata (F.)										X			
Paonis myops (J.E.Smith)			X					X					
Sphinx perelegans Edwards			X										
THYATIRIDAE													
Euthyatira semicircularis semicircularis (Grote)								X					
Habrosyne scripta scripta (Gosse)									X				
Pseudothyatira expultrix (Grote) ?					X								
TINEIDAE													
Monopis spilotella Tengstrom			X										
TORTRICIDAE													
Ahmosia galbinea Heinrich			X										
Amorbia humerosana Clemens					X								
Anopina silvertonana (Obraztsov)					X								
Apotomis deceptana (Kearfott)			X										
Choristoneura rosaceana (Harris)			X		X			X		X	X		
Clepsis persicana (Fitch)					X								
Cydia pomonella pomonella (Linnaeus)			X										
Dichrorampha capitana (Busck)				X					X				
Endothenia impudens (Walsingham)			X										
Epiblemma benignatum McDunnough													
Epinotia castaneana (Walsingham)					X								
Eucosma mediostriata (Walsingham)					X								
Eucosma smithiana (Walsingham)								X					
Grapholita packardi Zeller			X										
Hulda impudens (Walsingham) ?													X
Olethreutes atrodentana (Fernald)				X									
Olethreutes cespitana (Hubner)			X										

Table 1 (10 of 10).

	Pittsburgh Landing						Sheep Creek						GC
	V-1990	VI-1990	VII-1991	V-1992	VI-1992	VII-1992	V-1990	VI-1990	VII-1990	IX-1990	V-VI-1991	VI-1991	V-1992
Olethreutes fasciatana (Clemson)			X										
Pelochrista metariana (Heinrich)			X		X								
Phaneta corculana (Zeller)			X										
Phaneta pallidicostana (Walsingham)			X										
Phaneta striatana striatana (Clemens)			X										
Phaneta tomonana (Kearfott)								X					
Platynota idaeusalis (Walker)					X								
Ptycholoma peritana (Clemens)			X										
Sparganothis diluticostana (Walsingham)					X								
Sparganothis senecionana (Walsingham)					X				X				
Suleima lagopana (Walsingham)			X		X								
Total number of species	**3**	**1**	**81**	**3**	**53**	**0**	**2**	**60**	**54**	**65**	**34**	**2**	**28**

Table 2 Number of species of moths by family collected in HCNRA, 1990–1992.

Moth Family	Number of species
Arctiidae	6
Argyresthiidae	1
Blastobasidae	1
Cochylidae	1
Cosmopterigidae	1
Cossidae	1
Epiplemidae	1
Gelechiidae	1
Geometridae	64
Gracillariidae	2
Lasiocampidae	1
Lymantriidae	2
Noctuidae	73
Notodontidae	4
Oecophoridae	5
Plutellidae	1
Prodoxidae	1
Pterophoridae	8
Pyralidae	56
Sesiidae	1
Thyatiridae	3
Tineidae	1
Tortricidae	28
Yponomeutidae	13
Total	**276**

Table 3 (1 of 4). Insects other than moths collected in HCNRA by site and date, 1990–1992. PL: Pittsburgh landing, SC: Sheep Creek, GC: Granite Creek.

	PL	SC				GC
	V-1990	V-1990	VI-1990	VII-1990	IX-1990	V-1991	V-1992
ORTHOPTERA: ACRIDIDAE							
Dissosteira carolina (Linnaeus)					X		
Trimerotropis pallidipennis Burmeister			X				
HEMIPTERA: MIRIDAE							
Capsus cinctus (Kolenati)							X
Dicyphus sp.							X
Irbisia pacifica (Uhler)							X
Lopidea sp.							X
Polymerus nr. *rufipes* Knight							X
HEMIPTERA: PENTATOMIDAE							
Acrosternum hilare Say					X		
Brochymena quadripustulata (Fabricius)			X				
Chlorochroa sp.				X			
Coenus delius (Say)							X
Cosmopepla integressa (Uhler)			X				
Euchistus inflatus VanDuzee			X				
Euchistus variolarius (Palisot de Beauvois)					X		
Holcostethus limbolarius (Stål)					X		
Neottiglossa tumidifrons Downes							X
Thyanta pallidovirens (Stål)					X		
HEMIPTERA: REDUVIIDAE							
Fitchia aptera Stål					X		
HEMIPTERA: TINGIDAE							
Telionema nigrina Champion				X			
HOMOPTERA: CICADIDAE							
Okanagana oregona Davis				X			

Table 3 (2 of 4).

	PL	SC				GC
	V-1990	V-1990	VI-1990	VII-1990	IX-1990	V-1991	V-1992
HOMOPTERA: PSYLLIDAE							
Pachypsyllus celtidisgemma Riley*			X				
Pachypsyllus celtidismamma (Fletcher)*	X	X					
Pachypsyllus sp.	X						
COLEOPTERA: ANOBIIDAE							
Trichodesma cristata (Casey)				X			
COLEOPTERA: AMPHIZOIDAE							
Amphizoa insolens LeConte				X			
COLEOPTERA: BRACHYPTERIDAE							
Brachypterus urticae (Fabricius)							X
COLEOPTERA: BUPRESTIDAE							
Agrilus politus (Say)			X			X	
Anthaxia (*Melanthaxia*) sp.		X					
Dicerca hesperoborealis Hatch & Barr		X					
COLEOPTERA: CARABIDAE							
Nebria eschscholtzii Menetries	X						
Scaphinotus sp.						X	
COLEOPTERA: CERAMBYCIDAE							
Grammoptera molybidica (LeConte)	X						
Grammoptera subargentata Kirby		X					
Neoclytus acuminatus (Fabricius)			X				
Rosalia funebris Motschulsky			X				
COLEOPTERA: CHRYSOMELIDAE							
Calligrapha philadelphica (Linnaeus)							X
Macrohaltica prasina (LeConte)							X
Scelolyperus shwartzi Horn							X

Table 3 (3 of 4).

	PL	SC				GC
	V-1990	V-1990	VI-1990	VII-1990	IX-1990	V-1991	V-1992
COLEOPTERA: CICINDELLIDAE							
Cicindela oregona LeConte		X					
Cicindela repanda Dejean		X					
Cicindela tranquebarica Herbst		X					
COLEOPTERA: CLERIDAE							
Chariessa pilosa Forster		X		X			
Trichodes ornatus Say			X				
COLEOPTERA: CURCULIONIDAE: SCOLYTINAE							
Alniphagus aspericollis (LeConte)		X					
Pseudips mexicanus (Hopkins)							X
Scolytus rugulosus (Müller)			X				X
Xyleborinus saxesoni (Ratzebutg)		X	X				
Xyloborus dispar (Fabricius)			X				
COLEOPTERA: DERMESTIDAE							
Cryptorhopalum apicale (Mannerheim)		X					
Orphilus subnitidus LeConte							X
COLEOPTERA: LUCANIDAE							
Sinodendron rugosum Mannerheim			X				X
COLEOPTERA: SCARABAEIDAE							
Cremastocheilus sp.			X			X	
Trichiotinus assimilis Kirby			X				
NEUROPTERA: CHRYSOPIDAE							
Chrysopa oculata Say					X		
Chrysoperla plorabunda (Fitch)					X		
Dichochrysa sp.*				X			

Table 3 (4 of 4).

	PL	SC				GC
	V-1990	V-1990	VI-1990	VII-1990	IX-1990	V-1991	V-1992
NEUROPTERA: HEMEROBIIDAE							
Hemerobius stigma Stevens				X	X		
Hemerobius sp.				X	X		
Micromus variolosus Hagen				X	X		
Micromus subanticus (Walker)					X		
Wesmalius longifrons (Walker)				X			
NEUROPTERA: MANTISPIDAE							
Climaciella brunnea (Say)					X		
NEUROPTERA: MYRMELEONTIDAE							
Myrmeleon exitialis Walker				X			
NEUROPTERA: RHAPHIDIIDAE							
Agulla sp.			X				
HYMENOPTERA: FORMICIDAE							
Aphaenogaster sp.						X	
Camponotus vicinus Mayr						X	
Camponotus essigi M. Smith						X	
Hypoponeura prob. *punctatissima* (Roger)*						X	
HYMENOPTERA: TENTHREDINIDAE							
Strongylogaster distans Norton							X
TRICHOPTERA: HYDROPSYCHIDAE							
Cheumatopsyche arizonensis (Ling)			X	X			
LEPIDOPTERA: NYMPHALIDAE							
Phyciodes mylitta (Edwards)			X		X		
LEPIDOPTERA: PAPILIONIDAE							
Danaus plexippus (Linnaeus)	X				X		
Parnassius clodius Ménétries			X			X	
Total number of species	**5**	**11**	**19**	**13**	**15**	**8**	**16**