

COMMON, CONSPICUOUS, AND CURIOUS ARTHROPODS OF ZION NATIONAL PARK



**by Kenneth J., Kingsley, Ph.D.
with photos by the author, Ranger Amy J.
Gaiennie,
and others**

Common, Conspicuous, and Curious Arthropods
of
Zion National Park

by
Kenneth J. Kingsley, Ph.D., volunteer

An electronic photographic guide

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PICTORIAL TABLE OF CONTENTS



Woodlice (Crustacea: Isopoda: Oniscidea) also called Pill Bugs or Roly Polies



Arachnida (spiders, daddy longlegs, solifugids, and scorpions)



Coleoptera: beetles



Dictyoptera: mantids and cockroaches



Diptera: flies, mosquitoes, gnats

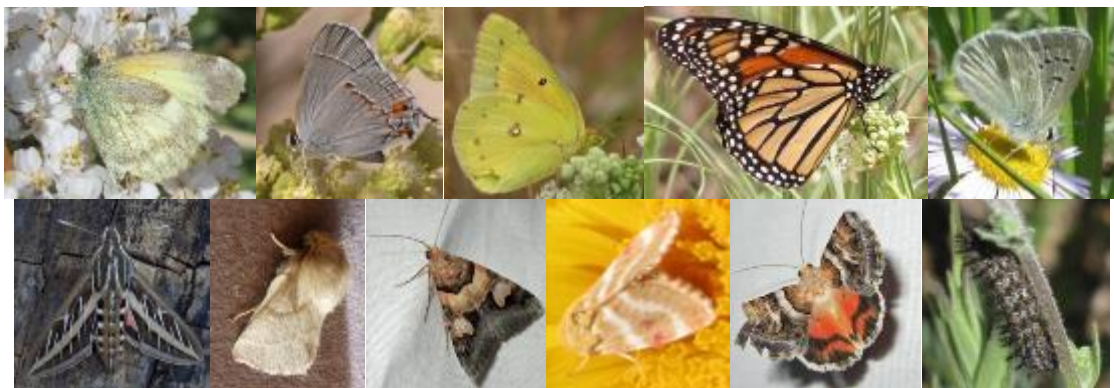


Hemiptera: true bugs, cicadas, hoppers, aphids and allies



Hymenoptera: bees, wasps, ants, and sawflies





Lepidoptera: moths, butterflies, caterpillars



Neuroptera: Antlions, lacewings and their relatives



Odonata: dragonflies and damselflies



Orthoptera: grasshoppers, crickets, and katydids



[Walkingsticks \(Order Phasmodea\)](#)



INTRODUCTION

PURPOSE

This is a short guide to the kinds of arthropods that are most likely to be noticed by visitors to Zion National Park. It includes:

- creatures that are especially common, at least at certain times of the year;
- creatures that are especially colorful or conspicuous in their behavior, such as by biting or otherwise annoying people or by flying around with colorful wings or being active in the daytime in places where people are;
- creatures that are especially important in this environment and/or have especially interesting life stories.

This is not strictly a “species” list because it includes generalizations about some kinds of animals that may have several closely related species that can only be distinguished from each other by specialists and microscopic examination. Instead of species identification, it will provide easy identification to the level that will be potentially most helpful to interpreters and the public. Deciding what to include or exclude from this list was challenging. There are probably several thousand kinds of arthropods in Zion National Park, and most of them had to be left out for practical purposes. In some instances, lists of species are available and provided for certain families, but in others I have provided only a count of species identified in the Park and

sometimes I do not have a clue as to how many species there may be. The ultimate deciding factors on what to include were my own interest and questions from visitors and interpretive rangers. Most aquatic species to be found in the Virgin River are absent because it would be impossible to photograph them with a permit that allowed their capture.



WHAT ARE ARTHROPODS?

This section is for the English majors among us, or those who have forgotten or never learned their basic zoological classification. However, even zoology majors might benefit by a bit of a refresher, and anyone who learned their taxonomy more than a decade ago might be surprised at how things have changed.

In order to help make sense of the diversity of life around us, scientists have devised a system of organization and classification that is based on current understandings of genetic and evolutionary relationships. The result is a conceptual framework that resembles a tree, with a trunk, several main branches, hundreds of big branches, and, ultimately, millions of leaves or twigs. Some call it the Tree of Life, and there is an excellent website based on this concept:

<http://tolweb.org/tree/phylogeny.html>

As a brief and general superficial overview, scientists have organized all of life into a series of nested concepts: Kingdom, Phylum, Class, Order, Family, Genus, Species, and Variety or

Subspecies. The easy way to remember the sequence is to remember the ridiculous sentence: “King Phillip Cried Out For Goodness Sakes Virginia (or Susan).” Biologists generally think they have a pretty good working understanding of what these concepts and categories are and frequently add super- and sub-categories to this framework. This is how an insect fits into the currently accepted scheme of organization:

Kingdom Animalia - Animals
Phylum Arthropoda - Arthropods
Class Insecta - Insects
Order Lepidoptera - Butterflies and Moths
Superfamily Papilionoidea - Butterflies
Family Papilionidae - Swallowtails
Subfamily Papilioninae
Genus *Papilio*
Species *rutulus* - Western Tiger Swallowtail (shown above).

The term “arthropod” is based on the Greek words for “joint” (*arthro* as in arthritis, irritation of the joints) and “foot” (*pod* as in podiatrist, a physician who specializes in disorders of the foot). Arthropods are generally characterized by the following features (any one of which may have occasional exceptions at some stage in the life cycle):

- Three or more pairs of jointed legs
- Segmented body
- Bilaterally symmetrical, meaning with two approximately identical sides (left and right)
- Possessing an exoskeleton, usually tough, composed in part of chitin, a complex proteinaceous material
- Having a ventral nerve cord.

At the present time, most biologists recognize some 17 Classes of Arthropoda, 99 Orders, 2,140 Families, and about 1.1 million described species and an unknown (but huge) number of undescribed species. Arthropods range in size from the smallest mite (about 0.10 mm) up to the King Crab (leg span more than 3.5 m), with most species in the range of 2 to 25 mm. Arthropods are found essentially everywhere on this planet, from the deepest ocean to the highest mountain. The range of options for arthropod life is endlessly astounding.

For our purposes, we will adopt a common classification scheme that will deal with the arthropods likely to be encountered in Zion National Park. This scheme is outlined below in a rough picture key.

NAMES OF ARTHROPODS

Arthropod scientific names follow a strict set of rules adopted by the International Commission on Zoological Nomenclature, and published in the International Code of Zoological Nomenclature. The intent of the Code is to encourage stability, accuracy, and universality of an organism’s scientific name. Scientific names do change for many reasons, however, including priority, improper use of Latin, misidentification, and other causes, all spelled out in the Code. In this document, the conventions of the Code are followed for the use of names: italicize scientific names of species and genera, and capitalize the genus name but not the species name, e.g.

Papilio rutulus.

Most arthropods do not have recognized common names. For some groups of arthropods,

various organizations have published standardized lists of scientific and English common names for some species in the group. The Entomological Society of America (ESA) and the American Arachnological Society (AAS) publish “official” lists of common names for insects and arachnids. The North American Butterfly Association publishes an “official” list of butterfly names, and the Dragonfly Society of the Americas publishes a list of dragonflies. There are undoubtedly others. Whenever an “official” common name is available, it has been used in this document. As a convention, an “official” common name is treated here as a proper name; that is, it is capitalized, e.g. Pallidwinged Grasshopper. A general term applicable to a large group, however, (e.g. grasshopper) is not capitalized.

HOW TO USE THIS GUIDE

This guide is arranged by orders (Lepidoptera, Hymenoptera, etc.) alphabetically. If you do not recognize the order, begin your search with the photos below and see if your unknown creature looks something like one of the photos. Follow through until you either find the creature you are looking for or learn that it is not in this guide. Maybe you will see the creature here, or something that looks sort of like it. Compare the general shape of your creature to the photos, and try the Order. Remember that most of the arthropods that occur in Zion National Park are NOT included in this document.

FOR FURTHER INFORMATION

Follow the links to websites that are imbedded here and throughout this guide in sections on specific kinds of creatures. All links were tested and found to be working as expected on September 20, 2014. However, of course I am not responsible for their continued maintenance and cannot guarantee that they will remain functioning.

The website: <http://bugguide.net/node/view/15740> is remarkably useful. It is user-friendly, phenomenally well illustrated, generally accurate, and reasonably complete.

The website: <http://www.cirrusimage.com/index.htm> connects to a huge collection of images of insects and spiders.

In my opinion, the book *Kaufman Field Guide to Insects of North America* by Eric R. Eaton and Kenn Kaufman is currently the best general guide available. The *Field Guide to Insects and Spiders of North America* by Arthur V. Evans is also excellent. There are many other good books, including those that have spiders and other arthropods, and those that are more or less technical and detailed.

BACKGROUND

Over a period of many years, scientists have collected arthropod specimens in the Park. The entire collection is at the Colorado Plateau Museum of Arthropod Biodiversity, Northern Arizona University, Flagstaff, Arizona. The curator, Dr. Neil Cobb, has compiled a database of specimens in the collection, which contains data on over 10,000 specimens of arthropods. To access information, a starting place is the website: <http://www.bugs.nau.edu/index.html>. Many of the specimens have not yet been identified to species. Species identification of some groups of arthropods is very difficult, and very few people have the knowledge to make accurate identifications to species. Some of the unidentified species may be unique to this area and/or new to science. Some groups of arthropods, especially bees and Virgin River aquatic species, have had focused studies that have resulted in a great deal of information and a relatively complete species list. Others have lots of room for future work. In some of the sections of this guide,

references are given to published works or unpublished files in the Park library that deal with specific groups of arthropods.

ACKNOWLEDGEMENTS

The idea for this document developed through a series of discussions with several members of the Zion National Park staff. Holly Baker and Mark Neidig offered encouraging comments and helped me understand what might work for the needs of the Interpretive Rangers and visitors. Amy Gaiennie reviewed and edited the draft and contributed many photographs and much insight. Neil Cobb, of Northern Arizona University, reviewed the collection of insects accumulated over many years by generations of scientists working in Zion National Park, and identified many of the specimens. Leslie Courtright provided electronic versions of the collection database, which was used as a starting place for this endeavor. This document is a revised version of an earlier electronic manuscript prepared with the inclusion of photographs taken without attribution from the internet, for use by rangers in the Interpretive Division for educational purposes. In this version, only photographs taken by the author, his wife, or friends who have given permission to use their work are used. Some species have been left out due to lack of photos.

Inspiring friend and author of the Kaufman Field Guide to Insects of North America Eric Eaton patiently reviewed the manuscript and offered many useful editorial suggestions and corrected my misidentifications.

CLASS CRUSTACEA—CRUSTACEANS, CRABS, SHRIMP, WOODLICE

WOODLICE (CRUSTACEA: ISOPODA: ONISCIDEA) ALSO CALLED PILL BUGS OR ROLY POLIES



These little creatures are popular with children because some species can be induced to roll up into a tight little ball. The rollers are only one family of an order of crustaceans (related to crabs and lobsters) that contains over 5,000 species in more than 30 families. They have rigid, segmented exoskeletons, 14 jointed limbs, and breathe through trachea-like lungs in their paddle-shaped hind legs (pleopods). They need to live in areas that are quite damp, such as under rocks or logs, because they rapidly lose water by excretion and through their cuticle. They are usually active at night, especially on rainy nights, but may also come out on rainy days. Mostly they eat dead plant matter, although a few species may be garden pests by feeding on strawberries and other soft plant parts.

When woodlice grow, they must shed the rigid exoskeleton. Unlike insects, woodlice shed in two steps: first the posterior half comes off, and then the anterior half is shed a couple of days later. Most arthropods shed their entire skins in one piece. Females carry fertilized eggs in a marsupium (pouch, like in a kangaroo) on the underside of their bodies. When the eggs hatch as tiny white babies, the mother appears to give birth to living young.

Zion National Park may have several species and families represented. It is generally considered that all of our sub-surface terrestrial woodlice are originally from Europe and not native to this country. A few species have adapted well to our climate by living in generally damp places and being active only on damp or rainy days. We currently do not know what species are here because identification would require collection, measurement, and examination of intimate parts, but we think there may be more than one species.

Those that can roll up are in the family Armadillidiidae and probably all ours are the species *Armadillidium vulgare* which has managed to make its home throughout most of the United States where most live near peoples' houses in damp places. Rolling up is a process called "conglobation" which is a rather rare defensive posture in the animal kingdom, shared with pill

millipedes, armadillos, and cuckoo wasps. Conglobation may be used as a defense against predators and also to reduce water loss. Woodlice can be kept as pets and may live for up to three years. Sometimes they are kept with pet tarantulas to clean up the tarantula's feces and food scraps and control mold and fungi.

CLASS ARACHNIDA (8 LEGS, TWO BODY SECTIONS)—SPIDERS, SCORPIONS, SOLIFUGIDS AND THEIR KIN



Arachnids are distinguished from insects by having more legs (eight) and fewer body sections (two—cephalothorax and abdomen or one with the two fused). Most known arachnids are spiders. There are over 43,000 species of spiders known worldwide, and previously undescribed species are discovered almost every day somewhere by arachnologists. It is thought that there may be somewhere near 80,000 species of spiders in the world. In North America, about 3,600 species have been described in 68 families. There are probably several hundred more to discover. Most biologists generally recognize eight orders of Arachnida today:

- Amblypygi - Tailless Whipscorpions, 150 species worldwide

- Araneae – Spiders, 43,000 species

- Uropygi – Whipscorpions, 100 species

- Opiliones – Harvestmen, 6,500 species

- Pseudoscorpiones – Pseudoscorpions, 3,400 species

- Schizomida - Short-tailed Whipscorpions, 230 species

- Scorpiones – Scorpions, >1,500 species

- Solifugae – Solifugids, 1,000 species

The Araneae, or Spiders and Mites, is the largest order, and both the most diverse and familiar. Mites, closely related to spiders, are very tiny and difficult to observe and identify. Spiders differ from other Arachnids in that they have the abdomen attached to the cephalothorax by a narrow stalk. Most spiders have eight eyes, although some have only six and a few have

none.

All known spiders produce silk, a complex protein substance, among the strongest known materials. Silk may be used for many different purposes. Many spiders make webs that they use to catch their prey. Many families of spiders create webs that are distinctive for the family. Silk is used to wrap prey, sometimes to immobilize it and sometimes to preserve it. Some spiders use silk to create shelters, either entirely of silk or incorporating leaves, bark, twigs, and other materials. Silk is used in mating and to create egg cases or sacs to protect developing young. Silk is also used to provide a secure anchor as the spider climbs, and to create a balloon to lift young spiders into the air.

Almost all spiders are venomous, injecting venom through their fangs, but very few spiders are capable of injuring human beings. Spiders lack chewing mouthparts, but feed by squirting digestive juices into their prey through holes that are poked by the spider's fangs and spines on the front legs. The juices dissolve the insides of the prey, and are sucked back out and into the spider's stomach. The empty husk of the prey is discarded like an empty can when the spiders have drunk the contents.

The American Arachnological Society published a list of the accepted common names of spiders http://www.americanarachnology.org/assets/pdfs/arachnid_common_names2003.pdf and publishes other information about arachnids.

A handy and fairly simple guide to the spiders and their kin is Levi, H.W. and L.R. Levi. 2001. *Spiders and their Kin*. Golden Press, New York. A new (in 2013), beautifully illustrated and highly detailed guide is Bradley, R.A. and S. Buchanan. 2013. *Common Spiders of North America*. University of California Press, which is available in both paper and electronic editions. A much more technical manual for identification is Ubick, D., P. Paquin, P.E. Cushing, and V.D. Roth. 2005. *Spiders of North America: an identification manual*. American Arachnological Society.

BugGuide has a great deal of information about spiders and many photos.
<http://bugguide.net/node/view/1954>

A list of spiders of Zion National Park by A.M. Woodbury dated 1928 is in the Interpretive Division Library, in one of the file boxes. It includes 13 families and 50 species, and a typewritten note. Many of the species of spiders on that list have had name changes, and some unknown number of new species have been named since 1928, but that list is probably a good starting place for anyone seriously interested in the spiders of Zion.

SPIDERS (ORDER ARANEAE)

Grass Spider (*Agelenopsis* sp., Family Agelinidae, also known as Funnel Web Spider)



One of our most conspicuous web builders, these spiders create a web that is a horizontal sheet on the ground with a funnel-like tube off to one side or in the middle, usually extending under an object or into a burrow. The spider hides down in the funnel, waiting for insects to fly into or land on the web. Then the spider will rush out and pounce, injecting its prey with venom. The venom acts fast, and the spider drags the subdued prey down into the funnel.

A fun trick for interpreters is to lightly tickle a funnel web with a small twig or piece of grass, imitating a trapped insect. The spider will usually pop out and check the disturbance, maybe even biting the twig. Sometimes, if you slowly approach the web, and look around the funnel or down into the funnel, you might see the spider. Sudden movements or changes in light (like your shadow) will cause the spider to retreat deep into the funnel so you most likely will be unable to see it.

These spiders are mostly nocturnal, and females seldom leave their webs. Mature males walk about in search of females. The typical life span is less than a year. After mating, the female makes a silk-covered egg case, lays her eggs in it, and dies shortly afterward.

Like almost all North American spiders, these creatures are harmless to us.

There are about 13 species in the genus in North America.

Banded Orb Weaver (*Argiope trifasciata*)



Perhaps our most beautiful spider, this large, colorful creature spins a fantastic web that may stretch over several feet in diameter. The Banded Orb Weaver is in the family Araneidae or Orb Weavers, the most famous of which starred in the book and movie *Charlotte's Web*. As far as is currently known, no members of this family can write or spell, although some make complex designs in their webs. This species is seldom seen until late summer or autumn, when they become full grown and make their conspicuous webs (if they are female). For the rest of the year, they are much smaller, make smaller webs, and blend in well with the shrubs in which they make their homes. Mature males do not make webs, but wander in search of females. Yes, this spider is venomous, but rarely bites humans and can do little damage if one should bite. They do seem to be quite effective at catching flying insects, and often build their webs in the tops of flowering shrubs or across spaces between shrubs or other objects where insects are likely to fly. Often the spider will rest in the center of its web, with legs feeling each of the eight main strands of the web, ready to dash out and catch any insect caught.

Tarantula (Genus *Aphonopelma*)



Tarantulas look fearsome, but are generally harmless large spiders. Although they do have venom, as do almost all spiders, they do not normally bite people. Even rough handling seldom results in an attempt to bite, so tarantulas are often kept as pets or used in scary movies for effect. The primary defense of tarantulas against their enemies is to remain hidden in a deep underground burrow. If caught outside, or dug up, the tarantula will use its secondary defense — urticating (irritating) hairs, which the spider kicks off its back into the face of its attacker. These tiny hairs are stiff and barbed and may be chemically irritating, but they are not venomous. They are easily inhaled, and can cause irritation to mucus membranes and allergic reactions.

Currently, 29 species in the genus *Aphonopelma* are recognized for the U.S. A recent key to the genus is available: Hamilton CA, Hendrixson BE, Bond JE (2016) Taxonomic revision of the tarantula genus *Aphonopelma* Pocock, 1901 (Araneae, Mygalomorphae, Theraphosidae) within the United States. ZooKeys 560: 1–340. doi: 10.3897/zookeys.560.6264. All U.S. tarantulas are classified as in the genus *Aphonopelma*. Species identification requires careful examination of specimens. *A. iodi* is the only species currently recognized from Zion National Park.

Aphonopelma zionis (Chamberlin) is a tarantula species named for Zion National Park, by University of Utah scientist Ralph Vary Chamberlin in 1940.¹ That species was sunk into *A. iodi* in the 2016 revision. Chamberlin and Ivie² also described a “new” species of tarantula

¹ Chamberlin, R. V. 1940. New American tarantulas of the family Aviculariidae. Bull. Univ. Utah 30(13): 1-39

² Chamberlin, R. V. & W. Ivie. 1939. New tarantulas from the southwestern states. Bull.

Delopelma iodium, with Zion National Park as a paratype locality. They included a photo of a male, and described this species as having a “rich rust color” and with the carapace pale buff. Subsequent taxonomists have redesignated this species as *Aphonopelma iodium* (Chamberlin and Ivie), and more recently as *A. iodium*. *Aphonopelma steindachneri* is another species that is still considered valid and was on Woodbury’s 1928 List of Spiders of Zion National Park, but was probably *iodius*, which had not been named in 1928.

Most of a tarantula’s life is spent underground, living in a burrow that it makes. It lines the burrow with silk, and extends lines of silk outward from its hiding place. It may open the burrow only at night, and plug it with silk or dirt during the day to maintain solitude and humidity. At night, the spider moves up to the top of its burrow and keeps its feet in contact with the lines of silk running outward. If a nocturnal walking insect should trip over a line, the spider runs out and bites its prey. Then, after the prey is paralyzed by its venom, the spider can take it below ground to store or consume at leisure.

Tarantulas live for many years, but how many is not really known for our native species. Females remain at home for all of their lives, remodeling to accommodate their larger bodies as they grow. Males are usually longer and slimmer than females and have much smaller abdomens on average. Males leave home when they reach adulthood, in the last few months of life, and go off in search of females. In nature, the lifespan of male tarantulas after they emerge may be measured in a matter of weeks, days, hours, or minutes. They have no interest in anything other than finding a mate. When he finds a female, she jumps on him as though he is prey. He has specially designed hooks on his forelegs for holding her at bay. He mates, then jumps away out of reach of his hungry mate. If he is lucky, he will get away and find another mate.

One of the major threats to tarantulas is a wasp called the Tarantula Hawk. See the description in the section on [Hymenoptera](#).

A European spider, *Lycosa tarantula* is also called “tarantula” and the Italian musical form the tarantella is named after them. Once believed to be seriously venomous, the only “known” cure was to dance vigorously. This was a reason for dancing that was acceptable to the Church. If you Google “tarantula” you may come up with this species, which is not related to our American tarantulas but is a type of wolf spider

Western Black Widow (*Latrodectus hesperus*).



Its scientific name means “murderous robber biting in secret.” The Black Widow is considered the most venomous spider in North America, and it is reported that its venom is 15 times more toxic than a rattlesnake’s. Fortunately, they rarely bite people because, when they do bite, the bite can be painful and toxic. The venom is neurotoxic, which means that it affects the transmission of nervous impulses, causing severe muscle contractions and spasms, including severe abdominal cramps and spasms. At first, the bite may be felt only as a mild pinprick. The severity of the victim's reaction depends on age and health, and on the area of the body that is bitten. The reaction may last for several days. Other symptoms can include nausea and profuse perspiration. If left untreated, tremors, convulsions and unconsciousness may result. When death does occur (in less than 1% of bites), it is due to suffocation caused by muscle contractions in the breathing system. The victim of a black widow bite should be taken to a doctor for treatment and care. Prompt treatment should result in rapid healing.



An adult female's body may be about ½ inch long, with legs much longer than the body. It is shiny black with red or orange markings resembling an hourglass on the abdomen. Males are tiny, the largest adults being approximately half the size of the female, and much skinnier. They are not black but red and white or brownish and white. Males are harmless to people. Juveniles of both sexes resemble the male and are harmless.

The black widow's web is typically a 3-dimensional mass of silk spun in a dark crevice, rodent burrow, or corner. It may appear disorganized to us, but is carefully spun from the spider's point of view. Only the lines anchoring the web to the ground are sticky. When an animal breaks a strand, it becomes stuck and pulled up into the mass of the web where it gets entangled. In Zion National Park, they are abundant in some sheds and garages (especially the Watchman Amphitheater sheds), in sheltered rock crevices (one at Petroglyph Canyon petroglyph panel back under the ledge), and in other places where they seek shelter from wind and rain. If the web is active (in use), the female will be near it by day and in or very near it at night, usually up in one corner in a hiding place. An expectant mother will have one or more egg cases, which are about ½ inch in diameter white spheres hanging in the web.

Black widow spiders range almost throughout the U.S. and into Canada and Mexico. There are five species, not easy to tell apart without close examination. This one and possibly one or more others may be here. All are sufficiently alike that you do not want to be bit by one.

It is rather difficult to provoke a black widow to bite a human being. In a series of experiments done by a student working on a Master of Science in Entomology at the University of Arizona many years ago, it was determined that deliberate provocation (poking) rarely resulted in a bite, but drove the spider into hiding. Accidental disturbance resembling an insect caught in the web, however, would result in a rapid attack by the near-sighted spider who could not easily identify what was in its web and did not want its food to escape. Legend has it that black widow spiders frequently build webs in old outhouses under the seat, the most frequent bites of humans are on male genitals. If the spider is caught between skin and an immovable object, such as clothing or a structure, it will bite in self-defense.

They typically prey on a variety of insects, but other arthropods and even small lizards that are caught in their net may do. When the prey is entangled by the web, the black widow quickly comes out of its retreat and attacks, wrapping it with silk and puncturing its prey with its fangs and injecting venom. The venom takes several minutes to take effect, meanwhile the prey is held tight by the spider. When the prey stops moving, the spider injects its digestive enzymes into the wound, detaches the prey from its web, and carries its prey back to its retreat before feeding.

Mating takes place in spring or summer. The story that the female always eats the male after mating is a myth. Yes, it can happen that way; but apparently, the majority of males do escape, especially if the female is already well fed. One mating is enough for the female, who can store sperm for months. She can make about nine egg sacs each containing about 400 eggs during her lifetime, which may be as long as six months.

Giant Huntsman (*Olios giganteus*)



These large spiders may be scary to some people, and can definitely be startling when they appear on your wall. They frequently enter buildings and walk around on the walls or ceilings. By day, they may hide behind a picture or wall hanging. They come out at night to hunt. Their more natural habitat is rock walls and tree trunks, where they blend perfectly and walk about in an endless search for insect prey. Females carry their egg sacs in their jaws and their young on their backs. Having no permanent web or other home, this method of caring for the young seems to work rather well. Huntsman spiders are in the Giant Crab Spider family (Sparassidae). They are venomous but rarely bite people and are not known to be especially harmful if they do bite.

Long-jawed Orb Weaver (*Tetragnatha* spp.).



These slender spiders typically build webs over and parallel to water, such as along the tributary streams in the Virgin River Valley. They can be found easily around the pools at middle and upper Emerald Pools. They are also common in The Narrows on rocks that overhang the river. The flat, sticky webs catch insects that come to or emerge from the water. The long jaws bear fangs that inject venom, but are not known to bite people. Angus Woodbury found three

species: *T. laboriosa*, *extensa*, and *elongata* in Zion National Park in 1928.

Wolf Spiders (Family Lycosidae)



These fairly large spiders can be seen running along the ground, often beneath dense vegetation. They are always hunting for prey--smaller insects that they find. Most wolf spiders are primarily nocturnal. They have eight eyes, two large eyes pointing forward and two large eyes pointing up, and a row of four small eyes beneath the large two in front. The eyes have a reflective coating that increases the amount of light the spider can see on a dark night. The reflective coating shines when struck by a headlamp, making it fairly easy to find wolf spiders at night. Like all spiders, they have eight legs, and those of wolf spiders are long and strong, well suited to carry the spiders quickly over the ground. Because they have no webs, the female spiders carry their eggs in a ball of silk attached to the underside of their abdomens. After the young emerge from the egg sac, they may ride around on their mother's back for a while before they set off on their own. Over 200 species of wolf spiders are known from North America.

Jumping Spiders (Family Salticidae)



Jumping spiders (Family Salticidae) are fun to watch—they are quick, active, have two large eyes in front, and look very intelligent. They run about on the ground or climb over plants, searching for prey. Their two larger eyes are very acute and capable of distinguishing prey and colors from over a foot away. Males engage in courtship dances with females, waving their pedipalps and front legs in a consistent pattern to let the females know that they are mates, not prey. Jumping spiders may be very colorful or may be well camouflaged against their surroundings. This is the largest known family of spiders, with 4,400 species known worldwide and more than 315 known from North America. Because most are small, camouflaged, and move quickly they are quite difficult to photograph well.

Crab Spiders (Family Thomisidae)



Look closely at this photo. Do you see the white spider sitting in the flower? This is a crab spider, waiting for an insect to come to the flower. It will pounce on its prey, injecting it with venom and hanging tightly with spikes on the front two pairs of legs. Crab spiders blend with their surroundings, some species able to change color from white to yellow depending on the color of the local flowers. Other species maintain their basic colors and patterns throughout their lives and live only on surfaces that match. About 130 species of crab spiders are known from North America.

DADDY-LONGLEGS OR HARVESTMEN (ORDER OPILIONES)



Daddy-longlegs can be easily separated from spiders by the broad fusion of the two body segments, so that the body appears to be composed of a singular segment suspended on long, springy legs. Members of this order do not possess silk glands, so they cannot form webs. They have no fangs or venom, but chew their food and swallow particles. Some are predators on insects, snails, and other small creatures, while others are scavengers, vegetarians, or omnivores. Harvestmen have scent glands that may secrete a defensive but nontoxic chemical repellant that may be irritating to predators.

They can often be found congregating inside caves, tunnels, and mines, in hollow logs, under large fallen trees or other sheltered locations. Congregations may reach several thousand individuals and look like a pulsating mass of intertwining legs and bodies. Nobody knows for sure why they do this. It appears that different kinds of Opiliones aggregate for different reasons. Some apparently aggregate to create, maintain, or take advantage of a desirable microhabitat (temperature, humidity, darkness, etc.). Other aggregations appear to be for purposes of hibernation or rest. It may be possible that the defensive secretions of a mass of Opiliones would be more effective than those of a single individual. In addition, the aggregations tend to pulsate wildly when bothered- a huge pulsating mass could be intimidating to predators. Many are beautifully marked if you look at them closely.

Uniquely among the arachnids, males possess penises and copulate with direct fertilization. Other arachnids have a somewhat more complex approach, copulating indirectly. Penis morphology is an important key to the taxonomy of Opiliones. We have no idea how many kinds there are in Zion National Park, because no one has done a survey. About 7,000 species have been named worldwide, but many more remain to be named.

SOLIFUGID (ORDER: SOLIFUGAE)



Solifugae is an order of the Class Arachnida, which includes spiders, scorpions and others. Some references call the order Solpugida. Other names by which these animals are known include: Solpugid, Camel Spider, Wind Scorpion, Sun Spider. There are 12 families worldwide, only two of which occur in the U.S., with 196 species currently known from North America and 12 from Utah. Zion National Park is the Type Locality for *Eremochelis gertschi* (Muma 1951), which was collected by Willis Gertsch, one of the great American arachnologists, in Zion National Park on the fourth of July 1932. The taxonomy of these creatures is difficult and currently undergoing revision. There may be several species in the park.

Although they are generally considered harmless, and are not venomous, they can bite with a sharp pinch if handled. These curious animals are not common, but they excite interest or panic whenever they are found. They can reach a total length of about two inches, much of which is legs and pedipalps. Solifugids are predators on insects and small vertebrates, and are eaten by birds, lizards, and grasshopper mice. They are nocturnal and occasionally come to lights, probably not attracted by the light itself but somehow by the insects that come to light. Most records are from specimens that were caught in pitfall traps. They can be seen walking around at night, their two pedipalps projecting ahead of them serving as “feelers” or sensory organs. Most are known to inhabit sandy or rocky soil where they burrow. Not much is known about their behavior or other aspects of their biology.

For more information: <http://www.solpugid.com/Introduction.htm>

SCORPIONS (ORDER SCORPIONES)



Scary though they may be, and quite capable of inflicting pain on us if provoked, scorpions appear to be quite rare in Zion National Park. There are several species present, although the so-called “dangerous” species appears to be absent. No thorough scorpion survey has been done in the Park, so we do not really know how many species may be here, but it is likely to be three or four species. The largest, Giant Desert Hairy Scorpion (*Hadrurus arizonensis*) is the most frequently seen. One or two smaller species in the genus *Paruroctonus* is also known to be here. One or more other genera may be present. Scorpions are best detected by use of pitfall traps, and it would be an intensive project to do a scorpion survey in the variety of potential habitats present.

Scorpions spend most of their time hiding from enemies and desiccation in burrow or under objects that keep moisture in the soil. They may emerge, or rest in the entrance of their burrows, on moist, warm nights during the summer rainy season. Occasionally they have been reported in some of the buildings here. The best, and most fun, way to search for scorpions is to use a blacklight (available as a “Scorpion Light”). Under the ultraviolet wavelength produced by these lights, scorpions fluoresce beautifully and can be detected from 20 feet away.

Scorpions eat mostly insects that they catch with their pincers (technically called “pedipalps”) and sting with the stinger in the scorpion’s tail. An excellent fact sheet on scorpions is available from Utah State University Extension Service.

<http://extension.usu.edu/files/publications/factsheet/ENT-68-08.pdf>

ORDER COLEOPTERA: BEETLES



Beetles are said to be the most diverse and abundant animals on earth. One out of every five known species of plants and animals is a beetle. Over 24,000 species are known from North America, and there are at least 113 families.

All beetles have a complete life cycle, with egg, larva (with several stages of growth), pupa, and adult. Most of the beetles seen in the Park are adults, and the eggs, larvae, and pupae are inconspicuous. Adult beetles generally have the following characteristics:

- Chewing mouthparts
- Distinctly segmented antennae
- First pair of wings hardened into stiff plates (called elytra) that do not overlap
- Second pair of wings membranous. The photograph below shows a beetle that has not quite folded its second pair of wings under its elytra.



Some of the most common and conspicuous beetles known in Zion National Park are listed and described below. There are many more to be found. In many cases, only one or two of the most common members of a family or genus is described here, so if you have something that sort-of looks like one here, you probably have a close relative.

An excellent available print resource for identification of beetles is: Evans, A.V. and J. N. Hogue. 2006. *Field Guide to the Beetles of California*. California Natural History Guides. University of California Press. Berkeley. 334 pp.

Excellent available Internet resources are:

<http://bugguide.net/node/view/60>

<http://www.sbnature.org/collections/invert/entom/cbphomepage.php>

In the 1920s and 30s, Vasco M. Tanner, a scientist from Brigham Young University, spent many years collecting beetles in Zion National Park. He published two articles³ listing the 333 species from 45 families he found, and he described seven species that were new to science with the type locality being Zion National Park.

GROUND BEETLES AND TIGER BEETLES (FAMILY CARABIDAE)

These fast-moving predators eat many other kinds of insects. Some 2,600 species are known from North America. Tanner (1928) listed 42 species from Zion National Park. Most can bite if handled. The kinds most likely to be encountered are:



Tiger Beetles (genus *Cicindela*, often placed in their own family Cicindelidae). There are over 100 species known from North America and at least 6 species of tiger beetles known from Zion National Park. They are small (about ½ inch long), fast-moving predators on other insects. Many are shiny and quite colorful, with contrasting markings in the form of stripes and spots. Some of the color is pigment, some refracted so it changes greatly as the angle of light changes and a beetle may appear green when seen from one angle and purple from another. Because of their beauty and interesting behavior, tiger beetles are prized by collectors and are one of the most studied of beetle groups. An excellent source of information about the tiger beetles of the U.S. is: <http://www.npwrc.usgs.gov/resource/distr/insects/tigb/index.htm>. This leads to an illustrated list of The Tiger Beetles of Utah.

³ Tanner, V.M. 1928. The Coleoptera of Zion National Park, Utah. Annals of the Entomological Society of America 21: 269-279. and Tanner, V.M. 1934. The Coleoptera of Zion National Park No. II. Annals of the Entomological Society of America 27: 43-49.



Mated pairs may often be seen running together in tandem. The male is on top of the female. She chooses the site to lay eggs individually in sand or earth that has a good texture for larvae to burrow.



Larvae live in circular burrows that they excavate. Usually there is a pile of dirt around the entrance of the burrow. The larva sits in wait at the top of the burrow and grabs insects that walk by. If you approach closely, the larva will drop down inside its shelter.



Caterpillar Hunter (*Calosoma scutator*, also known as Fiery Searcher). This beetle is more than an inch long, runs fast, and looks like it escaped from a jewelry store. It eats caterpillars, including the Western Tent Caterpillar, and will climb up trees to get them.



Larvae are also predators on caterpillars and the cocoons of tent caterpillars and other moths.

STAG BEETLES (FAMILY LUCANIDAE)



Cottonwood Stag Beetle (*Lucanus mazama*) looks like it could take a bite out of you, but the large jaws of the male are for fighting with other males to gain the favors of females. This beetle is in the family Lucanidae, the Stag Beetle family, named for the large jaws of males of some species that resemble antlers of a stag (or buck). The jaws of our species are not as big as those of some eastern and Old World species, but they can probably still give a good pinch if you pick up one of these beetles. Females have smaller jaws. Eggs are laid in rotting wood, probably cottonwood and also noted in some oaks, apparently with a preference for wet material. Larvae are C-shaped white grubs that consume the rotting wood.

SCARAB BEETLES (FAMILY SCARABIDAE)

This large family of beetles contains over 1,700 species in North America. Tanner listed 21 species in this family as known from Zion National Park. Some are colorful and conspicuous, but many are obscure little brown or black beetles that are very difficult to identify. The most conspicuous scarab beetles that are likely to be encountered in Zion National Park are described below.

Western Hercules Beetle (*Dynastes granti*).



This is a giant, over two inches long. Males have large “horns” that they use to fight each other. They use the two horns like pliers, each trying to grasp the other and throw it off the branch it occupies. Not often found, but unforgettable when encountered, this creature spends most of its life as a white grub, underground or in rotting stumps of trees. Adults feed on rotting fruit and sap. Males, and possibly females, scratch a wound into the bark of a rapidly growing ash tree branch, and sit tightly there licking up the flowing sap. Females and competing males may come to a well-positioned male. Adults may sometimes gather on logs (mating sites). Males fight over breeding sites, such as cavities in oaks. Pupation occurs in late summer. Adults hibernate in pupal cells in decaying wood. Eggs are laid the following summer. Large larvae overwinter, suggesting a two year (or longer) life cycle.



Rhinoceros Beetle (*Xylocertes thestalus*). This is another horned beetle, considerably smaller but more common than the Western Hercules Beetle. Larvae feed in decomposing leaf litter; adults feed underground on decaying roots and may come to lights at night. Only the males bear horns, and the one pictured is a female. Our Rhinoceros Beetles are dependent on the Velvet Ash tree (*Fraxinus velutina*). There is some concern that the introduced Emerald Ash Borer (*Agrilus planipennis*), a recent immigrant from the Orient which is killing ash trees in the eastern U.S., may move westward and destroy the only known food plant of this and other native insects. Specimens identified before 2009 were misidentified as *X. jamaicensis*, a close relative that does not occur in Utah.

Green Fig Beetle (*Cotinis mutabilis*)



This inch long shiny green beetle is abundant in late summer, mostly found feeding on nectar and pollen in flowers along the Virgin River. It is called “Fig Beetle” because the adults are often found on fig trees, also on peaches and other fruit trees, where they lay their eggs in damaged fruits. They may also lay eggs in animal droppings and decaying vegetation. Larvae are white grubs that live in dung, compost, or rotting fruit. Their legs are tiny and not very useful. When disturbed, the larvae crawl away on their bristly backs, which gives the name “back crawlers” or “crawly backs.” Adults fly noisily, with a sound that resembles a large carpenter bee. The wings can deploy for flight without spreading the elytra, using a special hinge. In flight, these beetles may resemble bees, which may deter some potential predators. Sometimes Green Fig Beetles will come to check you out if you are eating a peach or other aromatic fruit. They do not normally bite, but can give a pinch if handled. This is a southwestern species, related to the Green June Beetle which can be a pest of lawns and crops in the East, but ours is only a minor pest of some fruit crops.

May Beetles (*Phyllophaga* species).



Most of these look alike, little brown or black beetles that come to lights at night. There are at least 400 species in the U.S. Adults feed at night on foliage, larvae on roots of grasses and herbaceous plants.

DARKLING BEETLES (FAMILY TENEBRIONIDAE)



One of the most conspicuous creatures in Zion National Park is a large shiny black beetle that walks about day and night. Often seen crossing trails or squashed on roads, this is a Darkling Beetle, also called a Stink Beetle or a Pinacate Beetle (after a mountain range in Mexico where they are common). When a Darkling Beetle is accosted by a threat, such as a human being, it elevates its posterior, apparently standing on its head. It releases a noxious chemical mixture from its cloaca (rear opening) that may contain irritants of various sorts. If molestation continues, for example if you pick it up, the beetle may play dead, lying motionless until some time after it is put down.

In actuality, this is not just one kind of beetle, but several in the same family that resemble each other. The Zion National Park collection includes the following species:

Eleodes dissimilis nevadensis

Eleodes extricata

Eleodes hispilabris sculptilus

Eleodes obscura sulcipennis

Coelocnemis sulcata

Tanner, in his publications, lists 32 species in the family and the following species in addition to the above:

Eleodes carbonaria form interstitialis

Eleodes cognata

Eleodes extricata

Eleodes manni

Eleodes obsoleta var. *porcata*

Eleodes pilosa

Eleodes tenebrosa

Eleodes pimelioides var. *patruelis*

Eleodes negrina

Eleodes parawana var. *mimica*

Coelocnemis punctata

Coelocnemis tanneri = type locality = (this name has since been changed to *Eleodes tanneri*)

There is some uncertainty about the identification of this group of beetles, and the number of species. One source lists 141 species of *Eleodes*. Several of the species of darkling beetles have been reassigned to different genera, and there is apparently some inconsistency between the genera *Eleodes* and *Coelocnemis* which are very similar in appearance and behavior. Just call it a Darkling Beetle or Stink Beetle and you will not have to be concerned with the number and placement of hairs on the feet, curvature of parts of the genitalia, or other minute characteristics that distinguish the various kinds. All of these are primarily scavengers, consuming a variety of dead plant and animal material.



Mating pairs walk about together, entwined in an embrace that may last minutes to hours. This behavior makes them both much more likely to get squashed along the Pa'rus trail by bicyclists, since the beetles are completely engrossed in each other and not likely to get out of the way.

The defensive behavior is amusing to us, and probably effective against many kinds of predators, especially birds and most rodents and carnivores. The Grasshopper Mouse, however, learns quickly that if it shuts its eyes and attacks, it can grab a beetle and stick the insect's rear end into the dirt, thus rendering the defense ineffective. The mouse then proceeds to devour the beetle from its head end, leaving the butt sticking out of the dirt. The defensive chemicals are not especially harmful to people, but may irritate eyes if direct contact is made, so wash your hands if you handle these creatures.

METALLIC WOOD BORERS (FAMILY BUPRESTIDAE)



These beetles are usually seen in flowers, on tree trunks or fallen trees. They have a characteristic bullet shape, pointed at the rear end and blunt at the head. The adult beetles have a characteristic broad-shouldered shape and may or may not have metallic colors. There are some 750 species known from the U.S. and 15 from Zion National Park. Most species spend their larval stage in dead wood where they make meandering tunnels filled with frass (bug poop). Some species are forest pests, especially attacking trees that are weakened by disease or drought. The adult stage lasts only a few weeks, and many are very well camouflaged on the surfaces on which they rest. It may take several years for the life cycle from egg to adult because the food (dead wood) is not very nutritious.

The species most likely to be seen are in the genus *Acmaeodera*, a genus of more than 140 species, generally marked with yellow and black and about half an inch long. These are usually found on flowers or leaves. At least five species are known from Zion National Park. They are thought to mimic bees and thus avoid predators. They carry pollen between flowers. There are several other genera of beetles in this family that resemble this genus, and microscopic examination is necessary to identify them with certainty.

SOLDIER BEETLES (FAMILY CANTHARIDAE)



There are at least 470 species in this family of beetles in North America. Elytra are leathery, and often marked with bright colors especially red or yellow and black, which are warning colors that alert potential predators to the irritating defensive chemicals these beetles secrete when molested. Larvae live mostly in leaf litter or under stones and other debris or decaying wood where they are predators on eggs and larvae of other insects. Adults may feed on aphids and other insects and serve as pollinators of many kinds of flowers. Most common are *Chauliognathus fasciatus*, active in September and mostly found on yellow flowers.

LONG-HORNED BEETLES (FAMILY CERAMBYCIDAE)

More than 900 species of this family are known from the U.S. The Zion collection has 24 species so far. Many long-horned beetles are large and conspicuously colored. Adults have extremely long antennae, often longer than the body in males. Adults may be found on logs, tree trunks, flowers, or at lights at night. Larvae burrow in dead or dying plants, although some may mine live plants, either stems, trunks, branches, or roots. They have an important role in recycling dead wood. Some that have been found at Zion National Park include the following:



Flower Longhorns (subfamily Lepturinae). Often colorful, members of this subfamily are usually found in flowers where they feed on nectar and pollen. Because they are hairy, they may carry pollen from one flower to the next. This one appears to be *Judolia instabilis*, which is extremely variable in color and markings, from black and yellow to all black. Adults feed in several species of flowers. Larvae have been reared from the roots of milkvetches and lupines, common plants in our area.



Genus *Crossidius*. Four species of this genus have been recorded from Zion National Park. They are common in summer on rabbitbrush flowers. Larvae feed on the roots of rabbitbrush, sagebrush, and other Asteraceae shrubs. The colors suggest that it may not be a good idea to catch one, especially if you are a hungry bird. Some species with such markings feed on milkweed roots as larvae and retain the milkweed poison that causes immediate vomiting for any bird that eats them.



The **Whitespotted Sawyer** (*Monochamus scutellatus*) is a dramatically large beetle. Antennae of males may be three times the body length. Adults are active by day and feed on leaf petioles and the bark of twigs. They may also come to lights at night. There are several subspecies and variations of markings within this species, which is found throughout most of the U.S. in areas with conifers, especially pines. Larvae are miners in dead and dying trees. Despite the size, the larvae only require one or two years to mature. Identified by the tiny white triangular patch, called scutellum, at the front of the wing covers.



Spotted Pine Sawyer (*Monochamus clamator*) is very similar but more spotted and the scutellum is not a white triangle.

Both species can be found at higher elevations within Zion National Park, usually on trees. When on bark, they practically disappear from sight.

LEAF BEETLES (FAMILY CHRYSOMELIDAE)



Members of this family are colorful plant feeders, generally small. They are poorly represented in the Zion National Park collection, although they are probably much more numerous here. There are over 1,700 species of leaf beetles known in North America, and many species have yet to be formally described. Tanner (1928) found 27 species in Zion National Park.

The only species identified in the collection is *Diabrotica undecimpunctata*, the Spotted Cucumber Beetle (shown here). It feeds on many species of plants and can be an agricultural or garden pest. In Zion National Park, adults are common on the flowers of Coyote Gourd (*Cucurbita foetidissima*) which is common along the Pa'rus trail. Larvae feed on the roots of plants, adults on leaves and flowers. Adults can carry plant diseases from sick plants to infect healthy plants.

LADY BEETLES (FAMILY COCCINELLIDAE)



One of the most popular insects, the Lady Beetle (or Ladybug), is recognized as a good bug by most people. Gardeners love them for aphid control, and children like to tease them with a rhyme. There are more than 400 species in 58 genera of Lady Beetles in the U.S. Probably the most common and widespread is the Convergent Lady Beetle (*Hippodamia convergens*), which is common in Zion National Park. Adults and larvae feed on aphids and other “pest” insects, and can often be seen on flowers or leaves where their prey are. In winter, Convergent Lady Beetles congregate by the millions on mountaintops to get through the winter by hiding under blankets of snow. They fly down into the valleys in springtime and lay their eggs where they find aphids and mealybugs on plants. When the heat of summer arrives, most of the lady beetles move up into mountain canyons and highlands, where they reproduce and feed on the aphids on mountain wildflowers. In hot weather, they may hide in crevices, under logs, or in leaf litter to escape the heat. Larvae are less often recognized and look quite different from the adults. The orange and black warning colors on both adults and larvae may discourage some predators from eating Lady Beetles. When disturbed, Lady Beetles secrete a distasteful yellowish fluid from their knees that contains toxic alkaloids.

Vasco M. Tanner found 21 species of Lady Beetles in Zion National Park. This is the most common. Not all of the others are orange and black, but they all have essentially the same shape and life style.

BLISTER BEETLES (FAMILY MELOIDAE)



Members of this family have a more-or-less characteristic cylindrical shape, with an elongate body and tapered neck. There are 22 genera and approximately 410 species in North America. Eight species are known from Zion National Park. These range in size from 1/8 to 1 1/4 inches long. Some may be very colorful, with spots or stripes and contrasting, often warning, colors. Adult meloids feed on leaves and flowers of several families of plants, particularly Asteraceae, Fabaceae, and Solanaceae. Larvae are parasitoids. (A parasitoid kills its host; a parasite, if it is successful, does not.). Hosts include bees of families Megachilidae and Andrenidae. *Epicauta* (and other genera) larvae prey on eggs of grasshoppers. Many species lay their eggs in batches in soil near nests of hosts, and some lay theirs in nests of bee hosts. A few are known to lay their eggs on stems, foliage, or flowers, where the newly hatched larvae jump onto potential hosts that come to the plant.

Squashing, pressing or rubbing adult blister beetles may cause them to exude some of their hemolymph (“blood”), which contains cantharidin, a compound that causes blistering of the skin, thus the name blister beetle. Some members of this family have been called “Spanish Fly” and ground as a powder which has been used as an irritant to entice agricultural animals to mate. It has also been used as a “date rape” drug by unscrupulous male humans. It can be extremely toxic, especially causing severe irritation of mucous membranes and in large doses may be fatal.

ORDER DIPTERA: FLIES



Members of this order are characterized by having only one pair of wings. The second pair has been reduced to knoblike organs called halteres that are thought to act like gyroscopes to stabilize flight. Metamorphosis is complete, with eggs, larvae (most of which are wormlike maggots), pupae (which may be enclosed in the last larval skin), and adults. Most flies have large, prominent compound eyes. Most have short antennae, although some have long antennae. Mouthparts are either sponging or piercing-sucking, but some species have no mouths at all.

Many flies are aquatic as larvae and pupae. These include mosquitoes, black flies, midges, shore flies, many crane flies, deer flies, horse flies, and others. Some flies live in carcasses, dung, and decomposing vegetation. Some can spread diseases to and between people, either by carrying germs on their bodies and contacting our food or us, or in their bodies as parasites and viruses that are injected when they bite. However, most of the 17,000 species of flies known from North America are harmless or beneficial to human interests. Many are pollinators. Most groom almost incessantly, clearing their hairy bodies of dust, pollen, and other particulate matter. A few species are agricultural pests, while others are predators on other insects, including agricultural pests. The diversity of flies at Zion National Park has only been superficially investigated and warrants considerably more work.

CRANE FLIES (FAMILY TIPULIDAE)



They look like giant mosquitoes, but crane flies are harmless to people. These large, gangly flies often invade the restrooms in our campgrounds, attracted by the lights. In the morning, they head for the windows in a futile attempt to get out and find a daytime hiding place. Identification of crane flies beyond the family is impossible for any but the most astute and dedicated entomologist. There are some 1,500 species in 64 genera in North America. We have no idea how many species there are in Zion National Park, but the Park provides a diversity of resources for these creatures, so there are probably many more than have been identified.

When crane flies mate, they hang together tail to tail for as much as several hours. The curious formation looks like a very strange creature, indeed.



MIDGES, BLACK FLIES, NO-SEE-UMS, AND CEDAR GNATS

This group of insects represents several families. They are all tiny flies, but may be numerous and annoying. Some bite, and some just fly around our heads and maybe try to collect mucus from our eyes and noses, but most are generally harmless and have no interest in us.



Black Flies (Family Simuliidae) can be painfully annoying at times. In some parts of the U.S., they are a major hazard to outdoors people in springtime. There are approximately 165 species of black flies in the U.S., with the number of species and individuals increasing as one travels northward. Apparently, positive identification of some species requires microscopic examination of chromosomes in larvae. Here in Zion National Park, there are probably several species, but *Simulium virgatum* is the only one identified so far. Not all species bite, and some that do feed on animals do not bite people. Others can make people very uncomfortable by swarming on us. Some people are especially sensitive to the bites, and swell badly a day or two after being bitten. Black fly larvae live attached to rocks in moving water, where they filter small food particles and provide food for small fish. They often cluster in dense patches in the center of the moving water, hanging on to rocks by means of suction cups at their rear ends. They absorb oxygen through their skins and use brush-like mouthparts to capture tiny aquatic organisms. The presence of black flies is often an indication of the potential for trout, because the larvae are important as food for the fish.



BITING MIDGES, CEDAR GNATS, or NO-SEE-UMS (FAMILY CERATOPOGONIDAE) are tiny but may be very annoying. Most feed on the blood of other insects. Only a few of the 580 species in this family bite people, and those that do seem to show a strong preference for some people over others. Not everyone who is bit reacts adversely. Therefore, it is possible that they do not bother you. However, if they do, you will know it. Some people are highly sensitive to the bites of some species, and severe allergic reactions may occur. Larvae live under water or in damp soil as wormlike creatures feeding on microscopic material. Adults frequent river and stream valleys, especially areas with sandy soils. Only the females bite to obtain blood as protein to make eggs. Males feed on nectar and plant juices if they feed at all. Several genera are known to bite people, and each genus has many species. Identification of members of this family requires a good microscope and access to information that is not readily available. Moreover, there are probably many species that have not been named yet, especially among those that do not bite people. Some members of this family are notorious biters and can spread diseases to people. Others are harmless or even beneficial, not just as food for other creatures, but also as pollinators of such valuable plants as cacao—the source of chocolate.

Those that live in Zion National Park and are most likely to attract attention are sometimes called “Cedar Gnats” and are probably in the genus *Culicoides*. They seem to be especially attracted to people’s ears, where they not only cause itching but also make a painful noise. Repellants may help, and these pests do not fly very far, so just moving a few yards may suffice to get away from them. It is also possible that taking an over-the-counter antihistamine during Cedar Gnat season may prevent allergic reaction to them.

MOSQUITOES (FAMILY CULICIDAE)



Almost everyone can recognize a mosquito, but few people realize that there are 166 species in 13 genera in North America and over a thousand species in the world. In Utah, 49 species of mosquitoes are known. We do not know which species are present in Zion National Park because no thorough survey has been done, but there are undoubtedly several to more than a dozen. Mosquito habitats in the Park include irrigation ditches, river and stream flood pools, potholes in the slickrock, and holes in trees. It takes very little water to make habitat for mosquito larvae—I once found over 300 in a water-filled roadside beer can. Mosquitoes are found from the arctic to the tropics, almost wherever there is water that lasts a few days.

Eggs are laid on water or surfaces that are subject to flooding. Larvae are aquatic, worm-like creatures that breathe air through snorkels (correctly called “siphons”) and feed on microscopic organisms that they filter from the water by using brush-like mouthparts. They develop mostly in still or slow moving water. They are called “wigglers” because of their movement. Wigglers will usually sit close to the water surface, with their siphons actually open to the air above them and the mouthparts constantly filtering small particles. When disturbed, wigglers do a wriggling dive to the bottom and wait for the disturbance to leave before returning to their normal positions. Larvae go through four stages of growth (instars), each one larger than the previous. Then they transform into pupae, which do not feed, but float about in water until transformation into the adult stage is complete. When in the pupa stage, they are called “tumblers” because they tumble to the bottom when disturbed. They breathe air through two tubes that stick up above the water. The adult emerges from the pupa at the surface of the water, stretches its wings and hardens its exoskeleton, then flies off in search of food and a mate. Males and females get their nourishment from nectar and plant juices, but females of many species need to get a blood meal in order to make eggs for the next generation.

Not all species need blood, and many species do not bite people but prefer reptiles and birds. The species that do bite people are annoying and may transmit many diseases to people. Probably more people have died or been debilitated by the diseases spread by mosquitoes than in

all the wars in human history. Mosquito-transmitted diseases include malaria [caused by a protozoan], yellow fever [virus], filariasis [nematode], dengue [virus], and certain types of encephalitis [virus] including West Nile Virus that has been in the news in the past decade. Mosquitoes pick up the disease-causing organisms when they bite an infected person or animal, then transmit them when they bite another susceptible host.

NET –WINGED MIDGES (FAMILY BLEPHARICERIDAE)



An inch-long fly, *Blepharicera zionensis* is known only from The Narrows in Zion National Park. In the U.S., this family has 17 species in the Appalachian Region and 5 species in the west, all but this one in California. Observation requires a trained observer wading a mile upstream during the brief period between the last spate of snowmelt and water temperatures above 12 degrees Centigrade in the Narrows. The fly has a rapid development following diapause as an egg. Larvae and pupae live attached by hydraulic suction cups to rocks in water, the larvae feeding on diatoms and algae. Adults are active for a period of a few weeks in summer, and spend most of their time resting on rocks over rapidly moving water. Females are predators on smaller insects; males are not known to feed. Highly specialized eyes, differing greatly between dorsal and ventral surfaces, are a unique adaptation of this family, and may have differential functions for prey detection, predator avoidance, and avoidance of spider webs.

HORSE FLIES AND DEER FLIES (FAMILY TABANIDAE)

Most of the species of flies in this family bite. At least, the females do in order to get blood proteins to make eggs. The mouthparts are a combination of sharp dagger-like components that slice into flesh and sponging parts that suck up blood. An anticoagulant in their saliva may make the wounds they create bleed for some time. Tabanids may transmit such diseases as tularemia and anaplasmosis, but these are rare diseases in North America now. Like mosquitoes and other biting flies, only the females bite, the males feed on nectar and plant juices. Most lay their eggs on leaves above water, the larvae drop into the water and are aquatic or dwell in wet mud along the edge of water. Larvae are predators on other insects and worms. About 350 species in 30 genera of this family are known from North America.



Deer Flies (Genus *Chrysops*) There are probably more than one species in Zion National Park, but only *C. wileyae* has been identified. These pesky critters are generally gray in color, about the size of a house fly, with brilliantly-colored green eyes with dark spots or streaks. Deer flies are most common in wet woody areas. They can detect areas where lots of blood vessels are close to the surface, such as your scalp and the backs of your knees. Wearing a hat and long pants pretty well protects against these nasty biters. They also seem to know when your hands are full and you are too busy to swat at them.

ROBBER FLIES (FAMILY ASILIDAE)



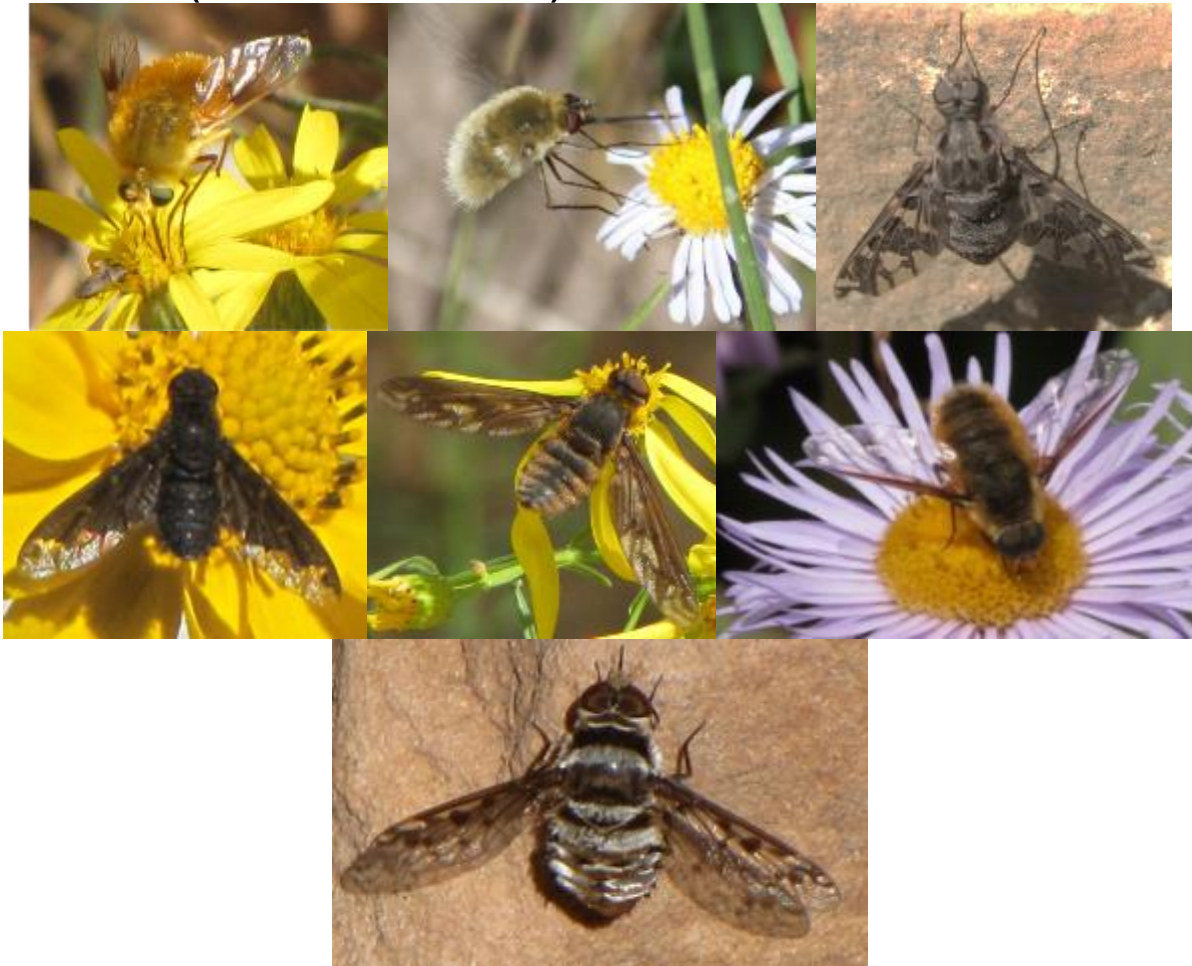
It has been said, “robber flies are to other insects what falcons are to other birds.” These are predators of other flying insects that typically perch on logs, rocks, twigs, or the ground, and dart out to capture their prey on the wing. Immature stages are poorly known, but are parasites of larvae of other insects. There are around 900 to 1,000 species known from North America.

These are medium-sized to large predatory flies. Most are gray, hairy, and have the top of the head hollowed out between eyes, with three ocelli (simple eyes) in this depression. The typical body form is elongated, with tapered abdomen, but there are other forms as well. The face is usually bearded. The mouthparts are modified to inject saliva into prey. The saliva contains potent neurotoxic and proteolytic enzymes. The antennae have three segments, the third segment is elongate. Some species resemble bumblebees. Robber flies occupy a variety of habitats, but are most diverse in dry, open habitats.

Adults lay eggs in the soil or in plants. Larvae are often predatory, consuming eggs and larvae of other insects in decaying matter. Robber flies typically overwinter as pupae and emerge in spring. Their life cycle takes 1 to 3 years. **CAUTION!** Large Robber flies may bite if handled roughly. Zion National Park has around 20 species documented in the collection, but there may be more present.



BEE FLIES (FAMILY BOMBYLIIDAE)



Bee flies are usually seen feeding at flowers or resting on rocks. They look a lot like bees (hence the name), but have only one pair of wings. They are mostly hairy, often brightly colored flies with slender legs. The wings are held outstretched at rest and often have dark markings. The eyes are usually almost touching above, especially in males. The mouthparts are a tubular proboscis either short with a broad tip or long and used to take nectar. Bee flies can hover and dart rather like hummingbirds. There are about 800 species of bee flies in 70 genera in North America and 4,600 worldwide. They may be 4 to 40 mm long. They are generally easy to identify as bee flies but very difficult to identify to genus and species.

Eggs are typically laid in soil near host habitats. Larvae feed on immature stages of beetles, bees, wasps, butterflies/moths, or on the eggs of grasshoppers. The life cycle usually takes one year. . Adults feed on nectar at a wide variety of flowers.

FLOWER FLIES (FAMILY SYRPHIDAE)



Members of this family may look even more like bees and wasps than the members of the Bee Fly family. The Bee Fly and Flower Fly (Syrphidae) families are reliably distinguished from each other only by examination of the wing veins, which requires specimens or exceptionally good photographs. As a general rule, Bee Flies may appear to be hairier than most Flower Flies, and Bee Flies tend to have spotted or otherwise marked wings, while Flower Flies tend to have unmarked wings. Some Flower Flies are not only marked like bees or wasps, but appear to imitate them in behavior as well. Most are marked with aposematic (warning) colors, as is common among bees and wasps that can sting. However, Flower Flies cannot sting or bite. They are harmless and may be important pollinators of many plants. There are more than 870 species in this family in North America, and many are very similar to each other in appearance. Larvae of some species live on plants and feed on aphids and scale insects, other species live as scavengers in aquatic or soggy habitats, and some live in nests of ants, wasps, or bees, where they may be predators or scavengers. At least one species, worldwide in distribution, is capable of surviving in human intestines if the eggs are accidentally swallowed. This causes a rare disorder, generally limited to Third World countries, called “intestinal myiasis.” Several species are present at Zion National Park, and some may be important as pollinators of our wildflowers. We cannot positively identify species without specimens, and even then, it would be quite difficult.

FAMILY CALLIPHORIDAE (BLOW FLIES)



Members of this family are about the size of a House Fly or a little larger. Some have metallic blue or green colors. Most are scavengers. The larvae live in carrion, excrement, and similar materials. Adults of many species feed in flowers on nectar and carry pollen on the hairs on their bodies. Some flies in this family lay eggs in wounds or freshly killed animals, and the larvae (maggots) consume the decaying flesh. One species, *Cochliomyia hominivorax* the Screwworm Fly was once a very important pest because it laid its eggs in the umbilical cords of newly born calves and other wounds in livestock. It has been greatly reduced in abundance throughout its range by the controlled release of irradiated sterile males that mate with native females and render the eggs infertile. One species, the Black Blow Fly (*Phormia regina*) is approved by the FDA for use in cleaning deep infections. The maggots only eat dead tissue and they secrete an antibiotic that prevents bacterial infection. Although it may seem incredibly gross to intentionally put maggots in a wound, they apparently do a better job of cleaning a wound and preventing scarring and infection than anything else known to medical science.

FLESH FLIES (FAMILY SARCOPHAGIDAE)



This is a large and diverse family, with roughly 250 species in North America. One genus, *Sarcophaga*, has 79 species, and can usually be identified by its red eyes and tail. We know the genus is here, but the species has not been determined—a process that requires microscopic examination of the male genitalia. These flies are known to persistently follow people around for some time, and land on you when you stop moving. The larvae are laid in fresh meat or dung. My hypothesis is that the adults recognize you as something that may kill something, or die, or at least provide some fresh dung. I call them “Doo-or-Die Flies.” One species *Sarcophaga haemorhoidalis* is named for its red tail, or (possibly) because it is a pain in the you-know-where.

TACHINID FLIES (FAMILY TACHINIDAE)



The present classification of these flies recognizes 303 genera and 1,345 species of Tachinidae in America north of Mexico. Representation from Zion National Park is very limited, and there are probably many species here that have not been collected or identified. This is the second-largest family in the order Diptera (behind Tipulidae). Many tachinids are similar in general appearance to House Flies and Flesh Flies. Many are large, bristly, and beelike or wasp like in appearance. Tachinid Flies can be found practically anywhere. They can be abundant on sunny hilltops looking for mates or feeding in patches of flowers. Larval stages are parasitoids of other insects. Almost every order of insects is attacked by Tachinids, including a few types of non-insect arthropods. Some Tachinids are very specific and others can parasitize a wide variety of hosts. The most common hosts are caterpillars. Most Tachinids deposit their eggs directly on the body of their host, and it is not uncommon to see caterpillars with several Tachinid eggs on them. Upon hatching, the larva usually burrows into its host and feeds internally. When fully developed it leaves the host and pupates nearby. Some Tachinids lay their eggs on foliage where they hatch into flattened larvae called planidia. The planidia remain on the foliage until a suitable host lands there or comes walking along, then they jump onto the host. Bristle placements (chaetotaxy), facial conformation, and antennal shapes are helpful in identifying genera. Genitalia may be necessary to identify species.



An assortment of Tachinid flies.

ORDER HEMIPTERA, SUBORDER HETEROPTERA: TRUE BUGS



When is it acceptable to call an insect a bug? According to convention, when it is a member of this suborder. I have never seen a clear explanation of why this is so, but it is the convention among entomologists.

There have been major taxonomic changes in understanding of this Order in recent decades. Most older books (and most older entomologists) call Hemiptera an Order, and Homoptera an Order. More recent books and recently trained entomologists designate the Order Hemiptera, with three suborders:

- Heteroptera (the old Order Hemiptera)
- Auchenorrhyncha (cicadas, leafhoppers, sharpshooters, treehoppers, and spittlebugs) and
- Sternorrhyncha (aphids, mealybugs, whiteflies, psyllids, phylloxerans, adelgids, and scale insects).

Insects in this Order have the following characteristics:

- Sucking, beaklike mouthparts held beneath the ventral surface of the head and thorax when at rest
- Incomplete metamorphosis—young go through a series of increasingly large stages until they emerge as winged adults; there is no pupa stage
- Juveniles (nymphs) resemble adults or may be very different in appearance
- Soft or hard-bodied, often flattened in profile

The suborder Heteroptera is so named because the forewings (hemelytra) are partly thick and protective, and partly membranous (hence the name “Heteroptera” which means “different wings”). Their hindwings are typically fully membranous and function in flight, though some species are wingless. (Juveniles have reduced wings.) Their wings at rest are crossed at the tip. A scutellum, which is a triangular portion of the thorax, is prominently exposed between the bases of the wings along the midline. The antennae, when not hidden, have 4 or-5 segments.

There are at least 3,583 North American species in this suborder, ranging in body length from 1 to 65 mm. Most species are terrestrial, but some are aquatic. The terrestrial species mostly feed on plant juices, but some are predatory or parasitic blood-sucking creatures such as Bed Bugs and Kissing Bugs. The aquatic species include predatory species and plant feeders. Some species are agricultural pests and others (blood feeders) are of public health concern.

AQUATIC HEMIPTERA (AND THOSE FOUND NEAR WATER)

BACKSWIMMERS (FAMILY NOTONECTIDAE)



These predatory insects occupy still waters, such as Emerald Pools and the many potholes in slickrock. They may be quite colorful, with red and black colors warning that they can bite hard if handled. Young ones, with undeveloped wings, look white or black-and-white, but they can still bite. They feed mostly on smaller insects, sometimes baby fish or tadpoles. They swim upside down (hence the common name), rowing themselves through the water with oar-like hind legs and grasping prey with their front legs. There are three genera in North America, with about 35 species. We have not yet determined the identities of those found in Zion National Park. Adults migrate from one pond or pool to another and may fly in clusters of hundreds or thousands from a drying habitat in search of a new place to live.

TOAD BUGS (FAMILY GELASTOCORIDAE)



Curious little creatures that look like baby toads, or maybe more like a glob of sand grains stuck together, Toad Bugs are found along the shores of our smaller streams, such as Birch Creek. These are predators on insects and mites. Our species is *Gelastocoris oculatus*. The name means “laughing” or “funny” bug with big eyes. They can bite if you handle them, but mostly they count on camouflage and rapid movement for defense. They are very difficult to see and somewhat rare.

WATER STRIDERS (FAMILY GERRIDAE)



Along the quiet edges and pools of the Virgin River, and on almost all quiet tributaries and larger rock pools, these insects skate over the water surface. They do not do well in rapidly moving water or riffles because they depend on the surface tension of the water to hold them on the surface. Their middle and hind legs are covered with fine hairs that repel water and spread the insects' weight so that they do not sink below the surface film. They are predators, with raptorial front legs, short beaks that inject a mild toxin, and good eyesight that enables them to capture small insects that come to the water.

Mating is a slow process; the pairs skate around together in tandem for hours and look like a strange creature indeed. Females lay their eggs at or just below the water's surface on floating objects.



Young look like miniatures of their parents but a bit stouter and with no wings. *Aquarius remigis* is the most widespread of the 45 North American species of Water Striders and is the only one that has been identified from Zion National Park, under its prior name *Gerris remigis*.

TERRESTRIAL HEMIPTERA (usually found on plants)

SEED BUGS (FAMILY LYGAEIDAE)



Members of this family have the membranous portion of the upper wings with five distinct veins that enclose only one cell. Many of the 295 North American species are inconspicuous, but some are brightly colored. Most species feed on seeds or sap. The most conspicuous species in Zion National Park are **Milkweed Bugs**. There are two species: the Large Milkweed Bug (*Oncopeltus fasciatus*) and the Small Milkweed Bug (*Lygaeus kalmii*). They are quite similar in appearance and both feed on milkweed sap and seeds. The small one is not only smaller; it has two white spots on the membranous portion of the forewings, while the Large Milkweed Bug has no white spots.

Young milkweed bugs have bright orange abdomens, developing black spots and becoming more orangish-yellow with age. These bugs accumulate milkweed toxins as they feed, and the bugs become more toxic over time. Adults and young may be found together on the milkweed along the Pa'rus Trail in late summer.

Eggs are laid in milkweed seed pods or in crevices between pods. About 30 eggs are laid a day and about 2,000 over a female's lifespan, which lasts about a month during the summer. There may be several generations per year, and the adults overwinter in hidden places.

SCENTLESS PLANT BUGS (FAMILY RHOPALIDAE)
Western Box Elder Bug (*Boisea rubrolineata*)



These colorful insects feed on the sap of Boxelder (*Acer negundo*), Maple (*Acer grandidentatum*) and Velvet Ash (*Fraxinus velutina*), all of which are common in Zion National Park. Adults may sometimes also feed on fruit. They are especially noticeable in spring and fall, when they come out of or congregate in their overwintering sites, which include buildings. In some years, enormous numbers of these bugs show up around lights and buildings. They can bite people, but it does not hurt much, and they mostly bite when they are being squashed on your skin. Therefore, the wise naturalist, feeling something crawling, sweeps it off rather than swatting it. There is also a Box Elder Bug (*Boisea trivittata*), found east of the Rocky Mountains, which is essentially indistinguishable from the Western Box Elder Bug.

LEAF-FOOTED BUGS (FAMILY COREIDAE)



This family has 33 genera and 88 species in the U.S. They are large (more than ¼ inch) plant-feeding bugs, many with expanded legs or spikes on their legs. They fly well, and some come to lights at night. If molested, they emit a sharp odor.

Coreids are usually dark colored and similar to Lygaeids (see Seed Bugs) but with many parallel veins in the membrane of the front wings instead of only five. Stink gland openings are present on the sides of the thorax between the legs. A few species of Coreidae are agricultural pests.

The most conspicuous species in Zion National Park are very similar in appearance and are in the genera *Acanthocephala* and *Leptoglossus*. *L. clypealis* (photo above) was observed feeding on developing cones on a Utah Juniper and is known to be a pest on some fruits. Another common species here is the Cactus Coreid (*Chelinidea vittiger*) (below) which is common on prickly pear cacti.



STINK BUGS (FAMILY PENTATOMIDAE)



Another name for this family is Shield Bugs, because they are shaped like medieval shields but calling them that is not recommended because it more commonly refers to the family Acanthosomatidae. They are called Stink Bugs because Pentatomids produce odors from thoracic glands for self-defense. There are 221 species in 61 genera in North America. This family is characterized by its broad, shield-like shape and five segmented antennae. The head is rather small and often tucked into a concavity in the front of the thorax. Superficially, the body (as viewed from above) appears divided into 5 sections, hence the name Penta (five) toma (sections). Members of this family are found throughout most of North America and the world. They are found in many different habitats, essentially wherever herbaceous plants grow. They are active from spring through fall and overwinter as adults under ground cover or leaf litter. Some species are strictly plant feeders, whereas others are predatory on other insects. A few are considered agricultural pests and are known to disfigure fruits by leaving feeding scars or allowing entry of pathogenic microorganisms.

After overwintering, adult females seek out suitable hosts in early spring and typically deposit their eggs on wild host plants. Stink bugs characteristically deposit their eggs on the underside of leaves in clusters with tight rows of individual barrel-shaped eggs. Shortly after hatching, emerging nymphs are gregarious in habit and remain on or near the egg mass. As they develop, they begin to feed and disperse. Stink bugs nymphs go through five stages of growth, called instars. Early instar nymphs may be brightly colored and striped, becoming more green or brown as they approach adulthood. A few species are brightly colored all of their lives, but most blend in well with the plants on which they feed.

In 1931, a paper was published based on research in Zion National Park (Woodbury, L.A. 1931. A list of the Pentatomidae of Zion National Park. *The Pan-Pacific Entomologist*. 7: 124-125). It listed 18 species as being present.

SUBORDER AUCHENORRHYNCHA (CICADAS, LEAFHOPPERS, SHARPSHOOTERS, TREEHOPPERS, AND SPITTLEBUGS)

CICADAS (FAMILY CICADIDAE)



The constant buzz of cicada song fills the air during the hottest days of summer in years when these insects are active. Males have a unique percussion system for sound production. On each side of the thorax, the male cicada has a membrane like a drumhead beneath which is a resonating chamber. He vibrates the membrane from the inside, using a large muscle. Each of the more than 160 species of cicadas in North America has a unique song, distinguishable to cicadas and to oscilloscopes, but difficult for us to distinguish most of the time.

Cicadas spend most of their lives underground, sucking juice from the roots of trees. Mother cicadas lay their eggs in twigs of living trees. The eggs hatch, and the nymphs fall to the earth and dig in to find a root. There they remain for one to 17 years (depending on species and location). Eventually, mostly with perfect timing within a few days of all the others of their species and generation, the nymphs climb to the surface, ascend the tree trunk or any other vertical object, split their nymphal skins (right photo), and emerge as adults (left and center photos). Males call in the daytime to attract females. Unfortunately (for them), they also attract birds and wasps that consume them. Cicadas are not active every year in Zion Canyon, and there may be only a few individuals active in any given year. There may be more kinds of cicadas here than have been detected and recorded so far.

LEAFHOPPERS (FAMILY CICADELLIDAE)



The name for this family comes from the diminutive for cicada, and these insects slightly resemble miniature cicadas. Unlike cicadas, however, leafhoppers have short life spans and do not spend most of their lives underground. There are some 2,500 species in this family in North America. Many are agricultural pests, especially those that are known to transmit various plant diseases. Leafhoppers get their name from their primary habitat (leaves and stems) and from their remarkable ability to hop (as much as 40 times their body length). Most leafhoppers are colored to match their surroundings. Some are called “sharpshooters” because they have the ability to eject their waste with such force that it may travel several feet. Our information on this family in Zion National Park is very limited, as very few have been collected here, but there are probably many to be found with a focused search.

SPITTLEBUGS (FAMILY CERCOPIDAE).



Young spittlebugs look a lot like spit on a twig. The froth is actually a mixture of the insect’s liquid waste with a mucous secretion and air bubbles. Beneath the froth, the nymphs sit sucking plant juices. The froth keeps the bug from drying out and protects it against predators and parasitoids (wasps that might lay their eggs in the spittlebug and kill it). Adults may resemble

tiny frogs and are called “froghoppers” for their squat shapes and jumping abilities. There are about 50 species in this family in North America, and we do not yet know which occur in Zion National Park. The nymphs are abundant on several different kinds of plants and may represent several different species of spittlebugs, but the adults are necessary to make a positive identification, and they are not easy to find and associate with their young.

SUBORDER STERNORRHYNCHA: APHIDS AND SCALE INSECTS

APHIDS (FAMILY APHIDIDAE)



Aphids are easily overlooked because of their small size. They are extremely difficult to identify because of their diversity (there are at least 224 genera and 1,351 species of aphids known from North America). Many species of aphids have complex life cycles in which most individuals in most generations are wingless and males are rare or unknown. Many reproduce by parthenogenesis (virgin birth) for several wingless generations, and then produce a winged generation that includes males and females that mate and disperse, sometimes to different species of plants than those on which they grew up.



Many species of aphids are attended by ants, which protect them from predators and parasites, keep them aggregated in herds, and feed on their excrement (honeydew). Some aphids spend the winter underground in ants' nests, protected as part of the food supply of the ants, which will take them to suitable plants in springtime and establish new herds of aphids.



The most conspicuous aphids in Zion National Park are **Milkweed Aphids (*Aphis nerii*)**, shown above, which are common on the Poison Milkweed. Like the Monarch and related butterflies, they pick up deadly cardiac glycosides from the host plant and deposit them in their bodies. Their bright yellow or orange color serves as a warning to predators-- at best they taste awful, at worst they can kill. Ladybugs appear to be immune to the toxins and may actually accumulate them to use for their own defense. Milkweed aphids are frequently tended by ants, which ward off ladybugs and other predators and parasites. The ants also appear to be immune to the toxins of the plant that must be at least somewhat present in the honeydew.

COCHINEAL SCALES (FAMILY DACTYLOPIIDAE, *Dactylopius* sp.).



White cottony-looking growth on prickly pear cacti are the hiding places of tiny insects that suck the plant juice. The white stuff is a protective waxy material that protects the insects from desiccation and predation. The insects' bodies produce a bright red substance called carmitic acid. This was used as a dye, first by Native Americans, then by Europeans. In fact, for many years, the natives were enslaved to harvest the insects, which were the major export of the New World to Spain. The industry crashed in the 1870s when dyes made from coal tar were invented.

Today carmitic acid is used where an “organic” red dye is the color of choice, such as in beverages, medicines, candy, and cosmetics. There are four species, and we do not know which one is here.

ORDER HYMENOPTERA: BEES, WASPS, ANTS, AND SAWFLIES



What is the difference between bees and wasps? Many people think of bees as “good” because they pollinate flowers and wasps as “bad” because they can sting. However, many bees can sting and many wasps are pollinators. Many species of wasps are also major pest controllers consuming zillions of caterpillars. As a rule, bees have thicker waists than wasps, and bees have branched hairs and are hairier. Wasps are less hairy and their hairs are not branched. Bees have special structures for carrying pollen, but wasps do not. These generalizations, however, are not consistent, and our understanding of relationships is constantly changing. Entomologists classify the Hymenoptera into families based primarily on morphological characteristics. The number of families is still changing as our understanding grows. Creatures that we call “bees” are in some families (Apidae, Megachilidae, etc.) and “wasps” are in others (Vespidae, Pompilidae, etc.), and “ants” are in their own family (Formicidae). Specific family characteristics that are fairly easy to see are discussed in the following sections, and some of the most conspicuous representatives of some families are described. There are approximately 17,000 species in the order Hymenoptera in North America. The current Zion collection (2008) lists 337 different species of Hymenoptera from the Park, but that is an unknown fraction of what is here.

Some of the members of this order are social insects, living in nests of thousands of related individuals, but most live solitary lives. Many are capable of stinging, but many are not. Some fly throughout their adult lives, and some only fly once to mate and disperse, then tear off their wings and become sedentary. Others have no wings at all, and in one family, the males have wings and the females do not. Some eat only nectar, some eat meat or meat juices, and some apparently do not eat as adults. Some are industrious gatherers of seeds and some are parasites so small that they can barely be seen with the naked eye.

Many species sting and the sting can range from barely noticeable to incredibly painful. The stinger is a modified ovipositor, originally developed for depositing eggs in places for larvae to develop. Many social Hymenoptera have sterile females whose stingers are especially well developed as organs of defense with glands that secrete venom. These insects live in large families with many helpless young and stored food, so good defenses are necessary. Some non-social Hymenoptera use their stings to capture, paralyze, or kill animals on which they lay their eggs. An entomologist (who has called himself a “hymenopteran venomologist”) named Dr. Justin O. Schmidt has worked out a scale of pain to describe the sensations inflicted by the stings of many Hymenoptera.

THE SCHMIDT PAIN SCALE OF HYMENOPTERAN ENVENOMATION

(From Wikipedia)

1.0 Sweat bee: Light, ephemeral, almost fruity. A tiny spark has singed a single hair on your arm.

1.2 Fire ant: Sharp, sudden, mildly alarming. Like walking across a shag carpet & reaching for the light switch.

1.8 Bullhorn acacia ant: A rare, piercing, elevated sort of pain. Someone has fired a staple into your cheek.

2.0 Bald-faced hornet: Rich, hearty, slightly crunchy. Similar to getting your hand mashed in a revolving door.

2.0 Yellowjacket: Hot and smoky, almost irreverent. Imagine W. C. Fields extinguishing a cigar on your tongue.

2.x Honey bee and European hornet: Like a matchhead that flips off and burns on your skin.

3.0 Red harvester ant: Bold and unrelenting. Somebody is using a drill to excavate your ingrown toenail.

3.0 Paper wasp: Caustic & burning. Distinctly bitter aftertaste. Like spilling a beaker of hydrochloric acid on a paper cut.

4.0 Tarantula hawk: Blinding, fierce, shockingly electric. A running hair drier has been dropped into your bubble bath.

4.0+ Bullet ant: Pure, intense, brilliant pain. Like fire walking over flaming charcoal with a 3-inch rusty nail in your heel.

ANTS (FAMILY FORMICIDAE)

Many people consider ants as the most fascinating insects, possibly because they are the most like us in behavior. Most live in large groups and have a complex social structure. Many species of ants are farmers, hunters and gatherers, warriors, slave-makers, social parasites, and exploiters of diverse resources. Some are pests to people, and some can inflict painful bites or stings. The basic ant plan includes one mother (the “queen”) of all of the ants in a group, multiple workers all of whom are sterile sisters with various work assignments based on morphology, age, and physical strength, and males that do essentially nothing except live for the moment of mating. In any given ant nest (often called an “anthill” or “mound,” sometimes “pissmire”), most of the action takes place out of sight, usually underground, where the queen lays eggs, babies are reared, males and potential queens lounge about waiting for their big moments, food is stored, various other creatures live off the ants’ industry, and communication and orientation are by complex chemical secretions and the ants’ incredible sense of smell.

Identification of ants to species is seldom easy. There are about 700 species in five subfamilies known in the U.S. A checklist of the ants of Utah published in 1942 contains 104 species, but there are undoubtedly more. New species, either newly discovered or recently imported (accidentally), are found frequently. A “new” species of ant, *Dorymyrmex paiute* Snelling, was named in 1995 based on specimens collected in 1932 in Zion National Park, and it is reputed to be known only from the Park.⁴ Taxonomists have been active in the past few decades, and many older names of ants have been changed. Mastery of a complex technical literature and a good microscope for examination of minute anatomical details are essential for accurate identification to species, although identification to genus is not so hard.

People who study ants are called “myrmecologists” after one of the Greek words for ant. Zion National Park has apparently not had a thorough ant survey done, although two of the great American myrmecologists (Creighton and Cole) collected here in the 1930s. The insect collection contains relatively few specimens from this family, with none currently identified to species. In the library files of the Interpretive Division is a one-page document that is a list of ants of Zion National Park. The author, or compiler, is unknown. It cites a document “Ingham, Ants of the Virgin River Basin” that I have not been able to locate. That list includes 21 species.

⁴Snelling, R. R. 1995. Systematics of Nearctic Ants of the Genus *Dorymyrmex* (Hymenoptera: Formicidae). *Contributions in Science*, Number 454, pp. 1-14. Natural History Museum of Los Angeles County.

ANTS OF ZION NATIONAL PARK

From Ingham, ANTS OF THE VIRGIN RIVER BASIN

(Source ZNP library files, dated 16 December 1968, source otherwise unknown. Some of the identifications may be correct) Names checked and updated 2015 by James C. Trager, without examining specimens.

Old names are in (), current names are used first.

1. *Pogonomyrmex rugosus* Emery (*Pogonomyrmex barbatus rugosus* Emery). Texan Harvester Ant or Agricultural Ant. Coalpits Wash.
2. *Pogonomyrmex occidentalis* (Cresson). Western Harvester Ant or Mound-building Prairie Ant. Coalpits Wash.
3. *Pogonomyrmex comanche* Wheeler (*Pogonomyrmex occidentalis comanche* Wheeler). A harvester ant. Zion Canyon and side canyons. (This is certainly a misidentification).
4. *Aphaenogaster (Attomyrma) boulderensis* M.R. Smith. Zion Canyon.
5. *Aphaenogaster occidentalis* Wheeler (*Aphaenogaster (Attomyrma) subterranea valide* Wheeler). West Rim.
6. *Pheidole bicarinata* Mayr. A harvester ant. Taylor Creek, Zion Canyon.
7. *Crematogaster (Acrocoelia) lineolata* (Say). Acrobat Ant. Emerald Pool Trail.
8. *Monomorium minimum* (Buckley). Minute Black Ant. Oak Creek Canyon.
9. *Solenopsis molesta* (Say) (*Solenopsis (Diplorhoptrum) molesta validiuscula* Emery.) Thief Ant. Zion Canyon.
10. *Liometopum luctuosum* Wheeler (*Liometopum occidentale luctuosum* Wheeler). Pine Creek, Clear Creek.
11. *Forelius pruinus* (*Iridomyrmex pruinus analis* (E. Andre)). Zion and Clear Creek Canyons.
12. *Dorymyrmex insanus* (Buckley) Earth-colored Ant. Taylor Creek.
13. *Dorymyrmex bicolor* Wheeler (*Dorymyrmex pyramicus bicolor* Wheeler). Zion and Side canyons.
14. *Dorymyrmex paiute* Snelling. Zion Ant. First described in 1995
15. *Tapinoma sessile* (Say). Odorous Ant. Zion Canyon.
16. *Camponotus laevigatus* (F. Smith). Giant Carpenter Ant. Zion Canyon and Clear Creek Canyon.
17. *Camponotus (Tanaemyrmex) ocreatus* Emery. A carpenter ant. Zion Canyon.
18. *Camponotus (Tanaemyrmex) vicinus* Mayr. A carpenter ant. Taylor Creek.
19. *Lasius neoniger* Emery. American Black Ant. Zion, Pine Creek, Clear Creek Canyons.
20. *Lasius (Chthonolasius) fallax* Wheeler. Pine Creek Canyon.
21. *Formica (Neoformica) moki* Wheeler. Zion, Heaps, Pine Creek Canyons.
22. *Formica (Neoformica) pallidefulva* Emery. Pine Creek Canyon.

The following information is based on observations and literature pertinent to the genus for each described, but it should be kept in mind that there may be several species of similar appearing ants in the genus and that each species will differ at least somewhat from its closest relatives. These are the ants one is most likely to see in Zion National Park. Sometimes it is easier to identify ants by their homes than by looking at the ants, and sometimes it is very difficult to find the homes.

Harvester Ants (Genus *Pogonomyrmex*) are the most conspicuous ants in the valley. There are 28 species in the genus in North America and three in Utah. The one most likely to be encountered here is the Western Harvester Ant (*Pogonomyrmex occidentalis*). Zion National Park is the Type Locality for the subspecies *Pogonomyrmex occidentalis utahensis*.



The name *Pogonomyrmex* means “bearded ant” referring to a complex structure of hairs on the face of the ant called a psammophore (sand carrier) that is used as a basket to carry sand and seeds.

Western Harvester Ant nests consist of foot-high mounds in the center of clearings up to about ten feet across. Each nest may contain thousands of workers and may extend six to ten feet down into the ground. All can sting and bite viciously in defense of their nests, which contain not only their entire family but also the food supply and the future generation.



The venom of Harvester Ants is among the most potent known toxins, and can induce severe pain and anaphylactic shock. It scores 3.0 on the [Schmidt Pain Scale](#). In laboratory studies, 12 stings will kill a rat. A *Pogonomyrmex* sp. sting produces intense pain in humans that lasts up to 4 hours, and the aftereffects can last for days.

Most of the food of Harvester Ants consists of seeds of many plants, which are gathered when they are abundant and stored by the bushel in chambers deep underground. Harvester Ants will also pick up dead insects that they encounter, and bring them home to share with the family. Often two or more ants will work together to bring home food that is too big for one to carry.

Harvester Ants are important as gatherers and distributors of seeds of many species of plants and as food for horned lizards and other reptiles. Horned lizards are resistant to the venom of harvester ants and feed on them. Several species of beetles live exclusively in Harvester Ant nests, where they fool the ants into caring for them.





Carpenter Ants (Genus *Camponotus*) are the largest ants we have, reaching almost an inch long. At least three species are known from Utah, mostly from high elevations, but there are probably more species present and not listed. They live in soil, often under logs or rocks, or they burrow in wood. They prey on live insects and/or scavenge dead ones. Their nests may be quite large. Carpenter ants do not sting, but can become pests of wood.





Acrobat Ants (genus *Crematogaster*) include 31 species in the U.S., and the number of species present in Zion National Park is currently not known but likely to be more than one. They are highly acrobatic, usually seen climbing over plants. These ants do not sting but can bite and ooze formic acid from the rear end and smear it on the bite wounds. They have heart-shaped abdomens, which are distinctive. They are scavengers, nectar feeders, and collect honeydew from aphids. Their nests are small and not easy to find, for they may be under stones or logs.



Crater-nest Ants (*Forelius pruinosus* and other species?) appear to be abundant almost everywhere in the Virgin River Valley, much less so on the slickrock where they cannot burrow. The nests typically consist of craters above ground, composed of soil excavated from below. They are tiny reddish ants, often with dark tips to the abdomen. These ants are mostly scavengers on dead animals, including lizards, birds, and insects. They also consume honeydew from aphids. Aphids feed on the juices of plants and excrete a sugary solution, especially if tickled by ants. In return, the ants may protect the aphids from predators and parasites. Crater-nest ants may also invade houses and campsites in search of sweets and fats. These ants move in narrow foraging columns to and from their nests, and may be active throughout the heat of the hottest days.

Zion Ant (*Dorymyrmex paiute* Snelling). This species was named in 1995 based on specimens collected in Zion National Park in 1932. It is apparently not known (or recognized) from anywhere else in the world. It may be one of the common crater nest ants found in the park, but more work must be done to determine its identity, abundance, distribution, and habits. The pictures are of a paratype specimen.



Little Black Ants (*Monomorium minimum*) are the clean-up crew for dead animals here and through much of North America. These tiny scavengers seem to be everywhere, at least in the main canyon of Zion National Park. In an experiment I conducted, Little Black Ants were on a dead mouse within ten minutes after I put it on the ground, and had reduced the mouse to a pile of loose fur in a few hours. Mostly these ants eat dead insects, and few dead insects will remain on the ground for more than a few minutes before the Little Black Ants find them. They will also come to picnics, especially if peanut butter and jelly are available.

VELVET ANTS (FAMILY MUTILLIDAE)



Insects in the family Mutillidae are often referred to as "velvet ants" because female members of the family lack wings and have coarse hairs that cover most of their body, making them resemble hairy ants. However, mutillids are not ants at all – they are wasps.

The Mutillidae family contains approximately 435 species. Most live in arid areas of the southern and western parts of North America. Little information is available about the biology of velvet ants, especially about their life cycles and development, but the following has been reported for most Mutillidae. Mutillidae are solitary parasitoid wasps that mostly attack mature larvae or pupae of other solitary Hymenoptera. However, velvet ants have been observed targeting non-feeding stages of Diptera, Coleoptera, Lepidoptera, Blattodea, and even some social Hymenoptera. Females have the difficult job of locating potential hosts. Suitable hosts may be difficult to find for several reasons including concealment, low population densities, and heavy defenses. Finding a matching reproductive pair can be difficult, if not impossible, for some species because of the extreme sexual dimorphism displayed within this family. Color patterns and the relative body size of the two sexes of the same species can be very different, making it very difficult to relate one sex with the other. Males are frequently larger (heavier) than the females and have wings, whereas females are wingless.

Velvet ants can sting, some quite severely (a 3+ on the Schmidt Scale). Because of this and their large size, some velvet ants are called “cow-killer ants.” Males cannot sting. Although they are not uncommon, velvet ants are not easy to find unless one wanders across your path. Because they move very quickly, they are also not easy to photograph well.

SPIDER WASPS (FAMILY POMPILIDAE)



Probably the largest and most conspicuous wasp you have ever seen, these giant wasps have orange and black colors to warn that they can really sting. Adults feed on flower nectar. There are 15 species of *Pepsis* and four of *Hemipepsis* in North America, but they are very difficult to distinguish from each other. Careful examination of the wing veins is the starting point for distinguishing them, but you have to catch the wasp first. This is NOT recommended. Identification of species by photographs is difficult at best and not likely to be possible.

Males have straight antennae; females have curved or curled antennae. Males cannot sting, but females pack extremely powerful stings. The venom causes excruciating pain that lasts for a few minutes, but does no harm beyond the pain. Some males of some species may have black wings, a relatively rare condition for the species found here.

Females can sometimes be seen in a searching flight pattern, close to the ground and running on the ground, exploring holes, searching for tarantula spiders. If the wasp finds a spider, it will lure the spider out of its hole, and a dramatic fight ensues. Usually, the wasp wins by stinging the spider in its central nerve ganglion and paralyzing it. The wasp then drags the spider to a suitable place and digs a hole. It lays one egg on the hapless spider and buries it in an underground chamber. The wasp larva eats the spider, starting with the non-essential body parts to keep the meat fresh. It may take several weeks to consume its food, then the larva pupates for a week or two or until the following spring, when flowers bloom to provide food for adults, and it emerges to repeat the cycle. Adults of both sexes feed on nectar, and their favorite flowers are those of milkweeds, especially the whorled milkweed (*Asclepias subverticillata*) which is common along the Pa'rus Trail. Tarantula Hawks are thought to be important pollinators of this plant.

Zion has several species of Tarantula Hawks, in two genera, plus several other genera of wasps in the same family, and all capture spiders.

MINING BEES (FAMILY ANDRENIDAE)



This family of bees has about 1,200 species in North America. One genus, *Andrena*, is nearly worldwide in distribution and has over 1,300 described species. 42 species in this family have been documented in the collection from Zion National Park.

These bees are solitary, not social, but may be semi-communal with several to many nesting close together. Mining bees are typically brown to black with whitish abdominal bands.

In spring, mining bees (both males and females) emerge from the underground cells where their pupae spent the winter. They mate, and the females then seek sites to dig nest burrows. The female excavates a small cell, and secretes a waterproofing substance to paint the wall. She gathers pollen and nectar and forms a ball, then lays one egg on it. She then seals the cell and digs another, several dozen or more for each female. Mining bees usually prefer sandy soils for a nesting substrate, near or under shrubs to be protected from heat and frost. In some species, several females may use the same burrow.

SWEAT BEES (FAMILY HALICTIDAE)



There are some 500 species in 21 genera in this family in the U.S., most of them in the genus *Lasioglossum* and many more that have yet to be described. At least 56 species have been identified from Zion National Park.

They are small to medium-sized bees (4-10 mm) and most are usually black or brownish. A few, however, are brilliantly colored metallic green or blue and marked with yellow or red. Thanks to intensive studies over many years, we have a fairly complete list of the Sweat Bees to be found in Zion National Park (see box, next page). Many of them look alike, but some are quite distinctive.

These bees are typically ground-nesters, with nests formed in clay soil, sandy banks of streams, and many other situations. Most species collect pollen from a variety of unrelated plants, but some are fairly to exclusively particular about which species of plants they visit. Some species are parasitic on other bees. A few species are attracted to sweat, and will sometimes sting if disturbed, though the sting is not very painful. The Schmidt Pain Scale ranks the sting of a Sweat Bee as “1.0 (on the scale of 1 to 4): Light, ephemeral, almost fruity. A tiny spark has singed a single hair on your arm.”

If you are interested in Sweat Bees, the following internet references may be helpful: [Interactive key to Agapostemon species](#) on Discover Life website, which is a fun way to learn about them.

Also the photos at: <http://bugguide.net/node/view/128/bgimage> are wonderful.

LEAFCUTTER, MASON, AND RESIN BEES (FAMILY MEGACHILIDAE)



Most members of this family are drab, black or gray in color, less than an inch long, and inconspicuous in their habits. Some, however, may be yellow and black, or brilliant metallic green, bronze, or blue. Taxonomy is challenging because of the high diversity and general similarity of species. Yet when entomologists devote a little time to the study of this group, they are endlessly fascinated. More than 600 species have been identified in the U.S. and Canada, and many have not yet been identified and given names. Most have not been studied in enough depth to tell us what they eat or where they live. A current total of 92 species in this family have been identified from Zion National Park.

The identifying characteristic of the family is a “pollen brush” on the underside of the female’s abdomen, which is used to collect and transport pollen to the nests. These are solitary bees. Although several may be found nesting in the same place, they do not interact socially and may not be related to each other. Many species are important pollinators of crops and wild plants. A few cut leaves from ornamental plants and may be considered pests because of the damage they do.

Members of this family typically make nests that are single cells, in either soil or wood. They line the nests with leaf fragments that are cut from living plants. Some species may use other materials, but most use leaves. They gather pollen and sometimes nectar into a wad placed in the cell, then lay one egg on the food. The larva eats the food left by its mother, then emerges from the nest as an adult to repeat the cycle.

Some species are cleptoparasitic on others, laying their eggs in the nests of their victims, their larvae consuming the provisions of their hosts.



Other species in this family may fall prey to one of our most colorful wasps, the Cuckoo Wasp, whose brilliant green body is extremely tough and impermeable to the stings of its victims. The Cuckoo Wasp will watch for Leafcutter Bees to leave their nests, then immediately after the mothers' departure will barge into the nest and lay her own egg. The larval Cuckoo Wasp will kill the baby bee and feed on its food.

CUCKOO, CARPENTER, DIGGER, BUMBLE, AND HONEY BEES (FAMILY APIDAE)

Taxonomy of this family is complex and has been revised several times. Older books separate this family into several families, but taxonomists that are more recent define them as subfamilies, with several tribes, multiple genera and subgenera, and about 1,000 species in the U.S. The subfamily Apinae includes the introduced Honey Bee and bumble bees (about 55 species in the U.S.). The subfamily Xylocopinae are carpenter bees, with small carpenter bees (Genus *Ceratina*—about 21 species) and large carpenter bees (Genus *Xylocopa*— about 10 species), most of which burrow in dead wood. The subfamily Anthophorinae (sometimes designated as a separate family Anthophoridae) are digger bees, with about 70 species that build solitary nests in the ground sometimes in large aggregations but without a social structure. The subfamily Nomadinae are cuckoo bees (about 400 species), cleptoparasites that lay their eggs in other bees' nests. The common characteristics of most members of this family are hairs that are branched like feathers (“plumose”), presence of a pollen basket of hairs on the hind legs, and mouthparts that are elongated (giving them the name “long-tongued bees.”). Social bees (honey bees and bumble bees, have large pollen baskets that collect globs of sticky pollen mixed with nectar. Solitary bees have more slender baskets (called “scopa”), used to collect dry pollen. One subfamily, the Cuckoo Bees (Nomadinae), however, lacks the pollen baskets. The Zion National Park list has 64 species of Apidae (35 in Anthophorinae) identified to date. A few of the most common and conspicuous are reviewed here.



Honey Bee (*Apis mellifera*). This common insect was introduced to the New World by Spanish settlers in the 1500s as a domestic animal, and to Utah by Mormon settlers in the 1840s. Feral descendants of the domestic colonies became established throughout the New World, and can be found almost everywhere there are flowers to provide pollen. Honey Bees are considered to be valuable pollinators of thousands of species of plants, and are the most economically important and intensively studied insects in the world. Unfortunately, we have no idea how they have impacted populations of native bees and other pollinators, and what the overall impact of this common animal has been on our native plants and animals. In our area, Honey Bees build their colonies in a variety of situations, including caves, cliffs, alcoves, rock crevices, and animal burrows. They defend their homes and stores of honey against predators by mobbing, each individual giving its life by stinging and leaving the stinger embedded in the victim. Honey Bees can be dangerous to people, and are statistically the most dangerous animals in the U.S., having directly killed more people than any other creature. Much has been written about Honey Bees, about their usefulness, behavior, susceptibility to disease, and economic importance. An excellent brief summary is presented in the Kaufman Field Guide to Insects of North America.

Large Carpenter Bee (Apidae: *Xylocopa* spp).



At least two species of Large Carpenter Bees are known from Zion National Park. They are similar in appearance, large black bees, but differ in that one, the Mountain Carpenter Bee (*Xylocopa tabaniformis*) looks as much like a Horse Fly (*Tabanus*) as a bee. It wears a jacket of yellowish to light gray fur. The California Carpenter Bee (*Xylocopa californica*), shown here, lacks the jacket and is shiny black. Both species burrow in wood, including dried yucca stems and occasionally buildings, excavating tunnels in which they build their nests. Large Carpenter Bees are not truly social insects, but may live in small groups, with a single male and two or more females.

Bumble Bees (Genus *Bombus*)



Bumble Bees are North America's only native social bees. There are some 55 species, most of which share the same basic appearance and life style. There has been a dramatic decline in some species in the past two decades, with some formerly common species disappearing entirely from areas. There are at least nine species documented from Zion National Park, and a possibility that several more may be found. All are large hairy bees that typically build nests in holes in the ground or out of dead grass on the surface of the ground. Careful examination of Bumble Bees reveals that they are quite diverse in their colors and patterns, that different species live at different elevations and in different habitats, that the different species may forage on different flowers, and that they may be active at different times of day. A useful and beautiful guide to the Bumble Bees of the West is published by the U.S. Department of Agriculture Forest Service and the Pollinator Partnership as a print book or pdf download: Koch, Jonathan, James Strange, and Paul Williams. 2012. Bumble Bees of the Western United States. www.pollinator.org/books.

The mated female spends the winter in quiet seclusion underground, and then gets busy in springtime building its nest and provisioning young with pollen mixed with salivary secretions. She will lay her eggs on a mass of pollen she has collected, and incubate them by covering them with her body to keep them warm. After about four weeks, the young grow up and join their mother in foraging and building the colony as the mother continues to lay eggs. Some worker bees spend most of their lives incubating eggs, keeping the eggs warm by covering them with their abdomens and vibrating their wings to increase body heat. Other individuals cool the eggs when they get too warm, fanning them with their wings. As the colony grows, the mother stays home and lays eggs, while worker bees take over the chores of foraging and caring for young bees. Males, which are rather rare but may be somewhat more colorful than females, do no work. They may leave the nest and forage on their own until autumn comes and they mate and die. Most of the workers live for only a few months, but the mated females may live for a year.

Foraging Bumble Bees are extremely industrious, visiting up to 44 flowers per minute, and some have been known to drop dead from exhaustion. Bumble Bees are especially good at foraging in flowers in the Pea Family (Fabaceae) and the Potato Family (Solanaceae), and have developed specific behaviors for getting nectar and pollen from flowers that offer challenges to other types of bees. Their nests are targets for foraging predators, and Bumble Bees can defend themselves by biting, stinging repeatedly without losing their stingers, and defecating on those

who attack them.

At Zion National Park at least nine species of Bumble Bees may be found. They generally can be told apart by the colors and patterns of their fur coats. However, positive identification to species cannot be made without careful examination of small parts of the body, such as cheek and leg details, and there is some individual variation as well, so our identifications are subject to change since they are based only on photographs and watching living bees in the wild. The most common species we have found are described below.

Nevada Bumble Bee (*Bombus nevadensis*)



This species is most common at lower elevations in the canyon, and can often be seen foraging in flowers along the Pa'rus Trail. The fur on this species is yellow on some segments, and black on the last three segments. There are no orange segments. Individuals are rather large, and tend to forage in large flowers. They have a strong preference for large purple or blue flowers with complicated structure like Lupines, Penstemons, Silverleaf Nightshade, and Larkspur. When in smaller flowers, such as Aspen Bluebells, the bee may be too big to fit comfortably in one flower, and may hang on to one with its hind legs while sticking its head into another flower to get its food.





Males are uncommon, slightly larger than females, and appear to be rather clumsy, and have an orange tip.

Black Tail Bumble Bee (*Bombus melanopygus*)



Smaller and more colorful than the Nevada Bumble Bee, the Black Tail Bumble Bee can be recognized by the two orange segments of the abdomen, with yellow segments above and below them and a black tail. There is a black band between the wings, and black hair mixed with yellow on the face and shoulders. Although there may be some individual variation within the population, this is the primary color pattern for this species. Black Tail Bumble Bees are likely to be found in a variety of flowers with various colors. They seem to like many species in the Asteraceae (or Compositae) such as dandelions and thistles, with an apparent preference for yellow flowers. Black Tail Bumble Bees are small enough that they can get into places that may be difficult for the larger Nevada Bumble Bees.

Hunt Bumble Bee (*Bombus huntii*)



This colorful bumble bee looks almost exactly like the Black Tail Bumble Bee, but its face and shoulders are entirely yellow and have no black hairs mixed in with the yellow. Also, its hair tends to be shorter and even, which makes it look a bit neater. These are not easy characteristics to distinguish, especially when the bee has its face buried in a flower.

Central Bumble Bee (*Bombus centralis*)



On this bumble bee, the orange segments are not followed by a yellow segment. The hair on its sides is long and shaggy and may be white or very light yellow. There is little or no black space between the orange segments, but the last two segments are black.

Squash Bees (*Peponapis* sp. and *Xenoglossa* sp.).



The common plant Coyote Gourd (*Cucurbita foetidissima*) that is conspicuous along the Pa'rus Trail depends on these uncommon specialist bees for pollination services. These bees will also pollinate other members of the Squash Family, and may occasionally cross-pollinate garden plants with native squash pollen—resulting in a horribly bitter fruit. There are only two genera of Squash Bees in North America. *Peponapis* spp. are about the size of honey bees. *Xenoglossa* (shown above) is larger, about bumble bee size, and males have yellow on the face and orange on the body. We do not know which species are present in Zion National Park.

Squash Bees fly before sunrise when the flowers are open. Males settle in flowers and wait for females. The females visit, mate, gather pollen, and fly to their nests, whereas the males spend the day sleeping in the withering flowers. Females dig nests in soil, making a straight tube with branches at the bottom. They provision each branch chamber with a ball of pollen and an egg, then close the chamber. The young develop over the winter, and emerge early the next summer to seek out squash blossoms.

YELLOWJACKETS, PAPER WASPS, AND HORNETS; POTTER, MASON AND POLLEN WASPS (FAMILY VESPIDAE)

This family includes some 415 species in North America. Some are solitary and some are social. Most have the ability to fold their wings longitudinally when at rest and have notched compound eyes. Many build complex nest structures of mud or paper. Diets of members of this family are variable and complex. For many species, the adult diet is nectar and pollen but the larval diet is caterpillars or other insects provided by the mother or adult siblings. Some species are scavengers and are attracted to any dead animal, including food being consumed by people.

Western Yellowjacket (*Vespula pennsylvanica*).



Of all the members of this family, this one is the most likely to be noticed in Zion National Park. These are also called “meat wasps” because they are attracted to meat. Foragers feed on meat, like the squashed toad above, and also nectar or sweet drinks. They will often show up at picnics, and outdoor eating venues, where they may wander into soft drink cans. After all, they are scavengers on dead animals of almost any kind. They nest underground in abandoned rodent burrows. The nest begins in spring, when a single female emerges from its overwintering site and starts a colony. She finds an abandoned rodent burrow or other suitable structure, makes chambers from chewed wood fibers, and lays her eggs in them. The young are sterile females.

The young mature and take over foraging duties and help build the nest and care for their younger siblings, while the mother devotes the rest of her life to laying eggs. The foragers find caterpillars, kill and chew them into wads which they then deliver it to the nest where they feed the larvae. The larvae then secrete a sugary substance that is consumed by the adults.. By the next winter’s first frost, the colony may have 5,000 individuals, all born of the same mother. At some point late in the summer, the queen produces eggs that grow into fertile females and males. These reproductives leave the nest in fall and mate with individuals from other nests. The males die, but the mated females seek out a place to spend the winter. Once the birth nest is abandoned by the reproductives, it starts to deteriorate, the queen dies, and the whole nest is killed by the first freeze.

Adults can sting repeatedly unless their stinger gets imbedded in their victim. The sting rates as a 2.0 on the Schmidt Scale. Yellowjackets will aggressively defend their nests against any disturbance, and will literally chase people away. Some people may be allergic to the stings. Yellowjackets occasionally fly into soft drink cans and sting the consumer on the lips or tongue.

Western Paper Wasp (*Mischocyttarus flavitarsus*)



This wasp builds nests of paper that it makes from chewed wood fibers. The nests look a bit like upside-down umbrellas, suspended from a narrow stalk beneath the eaves of buildings or in sheltered rock formations such as alcoves (example: Weeping Rock). The adults are predators on caterpillars. When a paper wasp captures a caterpillar, it chews the caterpillar to a pulp, which it then delivers to the nest for consumption by larvae. Paper wasps also store honey in empty nest cells, and feed it to adult nestmates. There are several other related genera that are similar yellow and black or brown builders of paper nests.

SOLITARY OR THREAD-WAISTED WASPS (FAMILY SPHECIDAE).



Great Black Wasp (*Sphex pensylvanicus*)

These creatures are what most people think of when they hear the word “wasp” referring to insects and not as an acronym. The characteristic wasp waist occurs in most of the 206 species in North America. The technical phrase describing this shape is “petiolate abdomen.” Wasps in this family may range in length from 10 to 30 mm. Females are predators on many other kinds of arthropods. Some wasp species are highly selective of their prey species, others are less so. They excavate burrows, utilize existing cavities (including other wasps’ and bees’ nests after the original inhabitants are gone), or make mud nests in which they rear their young. Most members of this family are black, and many have red or yellow markings.

These warning colors tell us that they can sting, and will if you get too close to their nests or

catch an adult. They mostly use the stinger for paralyzing and capturing insects or spiders that they use to provision the nests as food for their developing larvae. Adults feed on nectar, and some on the body fluids of their prey. Few species are known to be cleptoparasites, stealing prey from other wasps to use to feed their own larvae.

Nine genera are known from Zion National Park, but they have not yet been identified to species, and there are probably more that have not been collected.

There have been some major revisions in the taxonomy of this group of wasps, including at the family level, so some more recent sources may have these genera in different families. Most are fairly similar in general appearance, but differ in proportions and behavior. A few of the kinds that might be found in Zion National Park are:



Ammophila is a genus of 61 species in the U.S. They build simple, single-celled nests in sandy soil and provision them with caterpillars. Some species are known to use a pebble, held in their jaws, to tamp down the soil to close a nest burrow.



Wasps in the genus *Podalonia* are slightly stockier in build than *Ammophila*. They are known to feed mostly on caterpillars, one caterpillar per baby wasp. Unlike most of their relatives, wasps in this genus excavate their nests only after they catch a caterpillar.

ORDER LEPIDOPTERA: BUTTERFLIES AND MOTHS



Insects in this order share the following characteristics:

- Metamorphosis is complete; the insect has a life cycle that includes egg, larva, pupa, and adult.
- Eggs are laid by their mothers on or near the right kind of plant for larvae to eat.
- Larvae are elongated caterpillars. They pass through four or five changes of skin (instars), each one larger than the last, as they grow. The instars may be different colors, have different structures, eat different plants, and may have radically different lifestyles. Some even spend one or more instars as guests in ant nests, fed by the ants.
- The pupa appears to be quiet on the outside (although some may react to rude stimuli). A butterfly pupa is a chrysalis, covered by a tough skin that may be colored for camouflage and attached to a twig or buried in leaf litter. Many moths enclose the pupa in a silken cocoon, roll it inside a leaf, or bury it underground. Inside the pupa, a very dynamic process of change is taking place, which, when completed successfully, results in the emergence of a winged adult.
- Adults have two pairs of wings, forewings and hindwings. Adult wings are covered with tiny scales that come off easily and usually give color and pattern to the wings (the name Lepidoptera means “scaled wings”).
- Adults have tubular mouthparts (proboscis) that coil under the head and can be used to feed on nectar and other fluids. Adults of some species do not feed and may have vestigial mouthparts. Adult lifespan is typically short, only a few days to a few weeks, but there are exceptions to this rule.

This order is best known for colorful insects that are active by day (butterflies) and night (most moths). There are about 700 species of butterflies and more than 10,000 species of moths in North America. A good website for information on Lepidoptera in the area is:

<http://www.butterfliesandmoths.org/> Follow the links to get a list of species known from Washington County, Utah, and photos of most that have been recorded in this area. This list is very limited at present and does not include many species.

Other websites that might be helpful include:

<http://www.utahlepsociety.org/utmothchecklist.html> has a checklist of moths of Utah
<http://www.npwrc.usgs.gov/resource/insects/insect/leps.htm> provides an overview, and leads to an ever-updating supply of checklists and other information.

http://www.wildutah.us/index_btfly.html has photos, including some larvae, and other information of interest.

For printed references, my personal favorite is Brock, J. P. and K. Kaufman. *Kaufman Field Guide to Butterflies of North America*. Other useful books include:

Pyle, R.M. *The Audubon Society Field Guide to North American Butterflies*.

Opler, P.A. and A.B. Wright. *Peterson Field Guide to Western Butterflies*.

Stewart, B., P. Brodtkin, and H. Brodtkin. *Butterflies of Arizona. A Photographic Guide*.

Bailowitz, R. and D. Danforth. *70 Common Butterflies of the Southwest*.

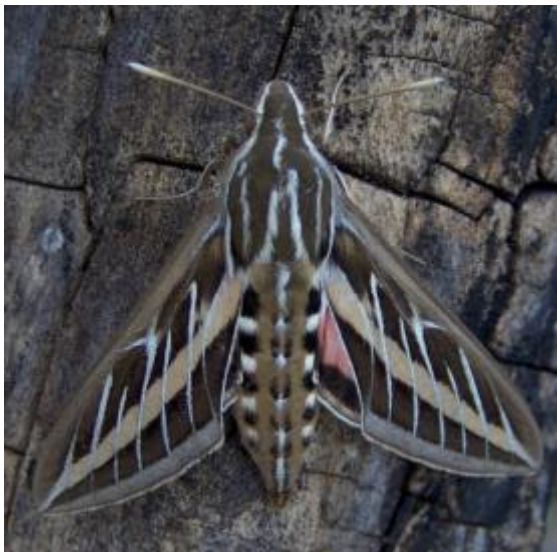
This order of insects is so popular that many books and websites are devoted to it. Most popular, of course, are the day-flying butterflies, and they have the most available and accessible information. Moths are much less appreciated and generally harder to identify, and have much less available information, however there are a few excellent references available on moths. Only a handful of the most common and conspicuous butterflies and moths were selected for this document, so please be aware that there are many more species present in Zion National Park. A whole book could be written just about the Lepidoptera here, which would be a worthy endeavor for a dedicated lepidopterist willing to devote several years just to this order.

BUTTERFLIES AND MOTHS

Distinguishing between these two sub-groups of the Lepidoptera is generally easy, but there are some exceptions to the following general rules. Butterflies are diurnal, often colorful, and their antennae end in knobs. Moths are generally nocturnal, often not colorful, but very well camouflaged, and their antennae are feathery or pointed. Moths have a special structure connecting forewings to hindwings, which butterflies lack.



Butterfly



Moth

FAMILY PAPILIONIDAE – SWALLOWTAILS

These large, colorful butterflies are quite conspicuous, most vividly marked with yellow and black. Several species are likely to be present, but the most common and conspicuous, at least in the main canyon is:

Western Tiger Swallowtail (*Papilio rutulus*)

This large, conspicuous, colorful butterfly can be seen almost anywhere in Zion National Park, especially near water, mostly in June and July. Adults feed on nectar of many species of flowers. Males patrol canyons and hilltops. Larvae feed on foliage of deciduous trees, including cottonwood, birch, willow, and aspen. Caterpillars rest in shelters made of silk and curled leaves. This butterfly overwinters as a pupa (chrysalis), and emerges in Spring or Summer. A closely related species, the Two-tailed Swallowtail (*Papilio multicaudata*) is slightly larger, has somewhat narrower black stripes, and has two tails (the inner much smaller than the outer). Unless you get a good look, they are not easy to distinguish. Often the “tails” get beaten up on vegetation or torn by predators.





Generally it is safest to call any large black and yellow butterfly you see a “tiger swallowtail” unless you get a really good look and can clearly see one or two tails on each wing.

WHITES AND SULPHURS (FAMILY PIERIDAE)

Members of this family are usually associated with plants of the mustard family, on which they feed as larvae and adults. Adults also may feed on many other kinds of plants, including asters and daisies. Adults of most species are primarily white, yellow, or orange, often marked with contrasting black, yellow, or green.

Dainty Sulphur (*Nathalis iole*)



The Dainty Sulphur (*Nathalis iole*) is very small. Its upper surface is yellow with black markings, the lower surface may be yellowish-green, with some orange on the fore wings. This little butterfly is most active in the spring when most of our mustards are in bloom, but some linger on through the summer and can be seen feeding at flowers in other plant families.

Orange Sulphur (*Colias eurytheme*)



This common butterfly is found throughout the U.S. Unlike many members of this family, this butterfly chooses legumes as its larval food plant. Several species of very similar appearing yellow butterflies also feed on legumes, and some may be pests in alfalfa and other legume crops. This species is very similar to a close relative, the Clouded Sulphur. In fact, the similarity is so great that they sometimes get confused and mate with each other producing hybrids. If you see a yellow or orange butterfly with some black markings on its upper surface, it is probably one of these two, so just call it a “sulphur” unless you get a really good look and see the orange on its upper surface.

GOSSAMER-WINGED BUTTERFLIES (FAMILY LYCAENIDAE)

Blues—Subfamily Polyommatainae

There are several species of little blue butterflies, collectively called “Blues” that can be found at Zion National Park. Identification beyond “Blue” may be difficult, and usually requires getting a good look at both the upper and lower sides of the wings. Almost 50 species of blues are found in North America. Caterpillars of some species secrete something that attracts ants, and ants will guard those caterpillars, sometimes taking them to the safety of underground nests and feeding them. The most common blues at Zion National Park are described below.

Boisduval's Blue (*Icaricia icarioides*)



Named after a French entomologist, Jean Baptiste Boisduval (1799-1879), who named, described, and illustrated many species of insects from North America, this little blue butterfly is found throughout most of the western U.S. It may appear very different in different parts of its range, but the black spots on the underside are always surrounded by white, and those on the lower wings may be completely covered by white scales. The upper side is blue with a black outline surrounded by a white fringe. The larval food of this butterfly is lupines. Adults may be seen at lupines, or feeding in other nectar flowers such as fleabane daisies. Males may gather at mud puddles to ingest dissolved minerals. When couples mate, they may fly together for an hour or more, which is a common phenomenon among butterflies.



Western Pygmy-Blue (*Brephidium exile*)



This tiny blue butterfly does not really have much blue to show except at the base of its wings on the upper side. The underside is gray with brownish-orange, and is marked with 4 or 5 tiny shiny spots. Larvae feed on saltbush and Russian thistle, which are common on the floor of the main canyon and partway up the slopes. Probably the best habitat for this species is along the lower reaches of the Watchman Trail, where larval food plants are common and adults can find Desert Marigold and other flowers for nectar.

Hairstreaks (Subfamily Theclinae)

Most hairstreaks are small grayish butterflies that look like they have a head at each end of the body. The wings of hairstreaks are shaped to resemble a head with eyes spots and antennae, and they are constantly moving. If a hungry bird tries to catch a hairstreak, it will probably go for the false head and take a harmless bite out of the wings while the butterfly flies away. Two common species are found in Zion National Park and a few other species may be found occasionally.

Gray Hairstreak (*Strymon melinus*)



This is a hairstreak found throughout the U.S. It eats a wide variety of plants, including legumes and mallows. It is not common in Zion National Park, but is always a delight to see. Males have orange abdomens, females have gray abdomens.

Juniper Hairstreak (*Callophrys gryneus*)



This colorful butterfly feeds on juniper trees, which are common at most elevations in Zion National Park. The butterflies are, however, not very common and a special treat to see up close in good light that brings out the iridescence of the green scales on the underside of the wings. The fake eyespots of some hairstreaks are reduced in this species, but it is still confusing as to which end is which.

Western Pine Elfin (*Callophrys eryphon*)



An easily overlooked little brownish butterfly, this hairstreak lacks tails and eyespots. Larvae feed on pine needles, and adults are almost always found close to pines, where the males perch on small trees or shrubs near the edge of clearings. This one was along Taylor Creek trail in the Kolob Section of Zion National Park.

BRUSH-FOOTED BUTTERFLIES (FAMILY NYMPHALIDAE)

This is a large and diverse family of butterflies, with many colorful and familiar species. The name “Brush-footed” comes from the front two legs, which are reduced in size and not used in walking, so these butterflies appear to have only four legs.

Variable Checkerspot (*Euphydryas chalcedona*)



One of our most common and conspicuous butterflies, Variable Checkerspots are found mostly feeding on yellow flowers. Its name come from the fact that this species varies greatly in its colors and markings throughout its range, which is most of the western U.S. and Canada, with many distinctive local populations. Most of those in our area look more or less like these photographs. Although the adults feed mostly on yellow flowers in the sunflower-daisy family and buckwheats, the larvae eat the leaves of snowberry, Penstemons, paintbrushes, and monkeyflowers. The caterpillar above is feeding on a paintbrush, one of our common wildflowers.

Northwestern Fritillary (*Speyeria hesperis*)



Fritillaries are easy to distinguish from other butterflies by their orange and black upper side in contrast to the pearly spots on the under side, but very difficult to distinguish from each other. They can be quite variable in color, markings, and size. I am fairly certain that this one is a Northwestern Fritillary, but there are at least six species of Fritillaries known from this area, and three are difficult to distinguish: Northwestern, Coronis, and Mormon. One must get a good look at both sides to be certain. All Fritillaries feed on violets as larvae and may feed as adults at many species of wildflowers.

Hoary Comma (*Polygonia gracilis*)



Flashing brilliant golden-orange wings, this butterfly seems to disappear when it lands and shows only the undersides of its wings. If you watch for a while, it will slowly spread its wings and you can see the contrast between upper and lower sides. The name “Comma” comes from the white mark on the underside of the hind wings, which resembles the punctuation mark. The larval food plants are in the currant family, and the adults feed in several kinds of flowers and often rest on dead branches on the ground, where they are very difficult to see. This species is most likely to be seen at higher elevations of Zion National Park, such as along the trail to Cable Mountain.

Field Crescent (*Phyciodes pulchella*)



This butterfly is widespread through the west, from sea level to high mountains, and can be common almost anywhere in Zion National park. . Its pattern is a little more subdued than those of some of its relatives. Usually Field Crescents fly low, from flower to flower, feeding mostly in members of the aster family. The name “Crescent” is for the crescent-shaped white mark on the underside of the hind wings.

Painted Lady (*Vanessa cardui*)

This widespread and familiar butterfly might be seen almost any time in Zion National Park. Painted Ladies are worldwide in distribution and often abundant, but they are not common in Zion. They migrate northward in the spring and summer from overwintering sites in places where they will not freeze. Sometimes migrating swarms of millions come northward from Mexico to settle in mountains and northern states. Other years they are challenging to find. Our climate is not great for these creatures, so they are seldom abundant here even though we have lots of wildflowers at which they feed.



Weidemeyer's Admiral (*Limenitis weidemeyerii*)



Larvae feed on willow, birch and some other trees and shrubs. Adults will take moisture from mud puddles, rotten fruit and animal feces. These butterflies are more common at high elevations, such as Lava Point or the East Rim trails.



Mourning Cloak (*Nymphalis antiopa*)



This butterfly can be found throughout all of North America south of the tundra, south to central Mexico, and in temperate Eurasia. It is most often seen in riparian areas, but may range widely. It is one of the earliest butterflies seen in spring because it overwinters as an adult.



Eggs are laid in groups circling twigs of the host plant. Caterpillars live in a communal web and feed together on young leaves from May to July. They eat primarily willow (*Salix* spp.) but also other trees and shrubs including Cottonwood (*Populus fremontii*), and Quaking Aspen (*P. tremuloides*). **Do not touch the larva**; its spines may cause a stinging sensation in some people if handled. The caterpillar does not really sting like a wasp or scorpion, but the spines can irritate skin that contacts them.

The pupa of the Mourning Cloak is harmless. Adults emerge in June, July, or August. They feed briefly, then estivate (sleep through the summer) until fall, when they re-emerge to feed and store energy for hibernation. Some adults migrate south in the fall. Adults feed primarily on tree sap (oaks preferred) and rotting fruit. They only occasionally feed on flower nectar.

Arizona Sister (*Adelpha eulalia*)



This common and strikingly beautiful butterfly is found throughout Zion National Park wherever Gambel's Oak (*Quercus gambellii*) is found. This species is widespread in most of Utah, Arizona, New Mexico, and parts of Texas and Nevada.

Taxonomy on this species is still being worked out, and many references still call this the California Sister (*Adelpha bredowii*), which some authors divide into at least two subspecies. Some older references put this in the genus *Limenitis*.

Larvae eat leaves of several species of oaks. The larvae may change colors from brown to green they mature. Young larvae make a curious structure from the midvein of an oak leaf, by chewing away the surrounding leafy material and extending the vein with a mix of silk and their own feces. They rest at the tip of this structure. Adults eat aphid honeydew, mud, fruit, and occasionally flower nectar. There may be two or more generations or "flights" in a year.

Monarch (*Danaus plexippus*)



The Monarch is one of the most recognizable butterflies in North America, and one of the most interesting. The bright orange and black warning colors broadcast danger to anything that eats a Monarch and is a classic example of “aposematic coloration.” The caterpillar is immune to toxins in the milkweed plants it eats and stores the toxins in its body. After transformation into a butterfly, the poisons are still present, and any bird that eats a Monarch will be sickened instantly and violently. That bird will never eat something again that looks like a Monarch. Adults feed on the nectar of several species of flowers, but only lay eggs on milkweeds, of which Zion National Park has five species. Monarchs are not common in the Park, although their food plants are abundant in some places, such as along the Pa’rus Trail. Adults migrate southward to Mexico, so some of the butterflies we see may be migrants moving southward. After spending the winter in Mexico, they move northward again in spring and lay eggs as they go. Monarchs that grow up here join those from the north and head south for the winter.

Queen (*Danaus gilippus*)



The Queen is slightly smaller than the Monarch, and lacks large black veins on its wings. It is closely related to the Monarch, and also feeds on milkweeds as a larva. Queens may be somewhat more common than Monarchs in this area. Adults feed on the nectar of many plants, including milkweeds and the invasive Salt Cedar (*Tamarix chinensis*).

SPHINX MOTHS (FAMILY SPHINGIDAE)

Sphinx moths are usually large, fast flying, and colorful. Most are tropical. Most feed on deep or complex flowers, using extendable tongues that may exceed the length of their bodies. Some species may be active during the daytime, but most are nocturnal. A few may be important agricultural pests, such as the Tomato Hornworm and Tobacco Hornworm, but most are uncommon, innocuous, and prized by collectors and observers for their beauty. About 127 species are known from North America. Caterpillars often have horns, which are harmless but may deter some predators. Sphinx moths do not build cocoons, but pupate in the soil, usually beneath their host plants.

White-lined Sphinx Moth (*Hyles lineata*)



This beautiful moth is about two inches long, with a proboscis that is longer than its body. It feeds from dusk through the night and may occasionally be active in the daytime. Flowers it feeds on include the Sacred Datura and other members of the Potato or Nightshade Family, milkweeds, legumes such as milk vetches, and evening primroses.



The caterpillar may be green, yellow, or black in base color, usually has longitudinal stripes, and has a horn on its rear end. Caterpillars feed on many species of plants. Caterpillars may occasionally have local population explosions in which thousands may be seen covering plants and walking on the ground. The pupa stage is spent underground.

Five-Spotted Hawkmoth (*Manduca quinquemaculata*)



"Manduca quinquemaculata adult female". Licensed under Creative Commons Attribution-Share Alike 2.5-2.0-1.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Manduca_quinquemaculata_adult_female.JPG#mediaviewer/File:Manduca_quinquemaculata_adult_female.JPG

This moth is named for the five (*quinque*) yellow spots (*maculata*) on its sides. A closely related species, *Manduca sexta* has six spots. It is one of our larger moths, with a wingspan of over five inches. Its tongue is longer than its body, and can reach deep within the flowers of Sacred Datura (*Datura wrightii*). This moth has an important symbiotic relationship with Sacred Datura—it is the primary pollinator of the flowers, and the moth benefits by drinking the rich nectar. The nectar is intoxicating, as are all parts of the plant, and moths become addicted to it. Moths will frequently lay their eggs on other related plants as well, such as tomatoes (where the caterpillars are called “tomato hornworms”) and tobacco, eggplant, and peppers. Moths fly very quickly and are difficult to catch or photograph, hence the photo above is of a specimen obtained from Wikimedia.



Eggs are laid on the leaves of the plant, and the caterpillars feast on them with little competition. Caterpillars sequester (store) the toxins in their bodies, and that may protect them from caterpillar eaters. Caterpillars may be green with white stripes in a chevron pattern, or rich brown to almost black with yellowish stripes. They blend in well with the plants, so are normally very difficult to see. They spend their days hiding and nights devouring leaves of Datura (or tomatoes). After growing to a length of three inches or more, the caterpillars dig in the soil and go into their pupal stage. They spend the winter underground, and emerge in the warm days of summer as moths.

TENT CATERpillARS (FAMILY LASIOCAMPIDAE)
Southwestern Tent Caterpillar (*Malacosoma incurvum*)



Tent

Caterpillars on tree trunk

Up in cottonwood, and to a lesser degree, willow trees, you may see cobwebby tents in springtime. These are the homes of the Southwestern Tent Caterpillar. They have an annual cycle that is closely tied to the cottonwood tree. Caterpillars spend the winter as eggs, grouped by their mother into a mass of up to two hundred on a twig of a host tree. In our area, the best host trees are cottonwoods, which are abundant along the Virgin River, although willows and other plants may be used. The eggs hatch in spring, when the new leaves have emerged on the trees. All of the caterpillars from one egg mass live together on the branch where their eggs were laid. Together they spin the silk that makes the tent. As the caterpillars grow from $\frac{1}{4}$ inch to an inch and a half long, they feed on the leaves of the tree and spread along the branch to reach other branches. As the caterpillars grow, they keep building the tent, until it grows to as much as a couple of feet long and wide. Sometimes, for unknown reasons, the whole bunch of caterpillars may move to a new nest and abandon the old one. Sometimes there are several egg masses on a tree, and the tents from each sibling group of caterpillars may merge to totally cover a small tree. The tents provide protection against predators and parasites and shelter from wind and rain. The down sides of this kind of communal living are that the caterpillars can eat themselves out of house and home, and diseases can spread rapidly through the group and kill them all.

The tree may be totally stripped of leaves by caterpillars early in the season. Then the caterpillars have to move to a different tree. Our cottonwood trees are well adapted, and will grow a new set of leaves, which appear to be less palatable to caterpillars. Sometimes, though, very young trees, or trees that are not healthy, will not survive.

Preying on caterpillars is a beetle that grows to over an inch long and looks like an escapee from a jewelry store. This is the Caterpillar Hunter. Larvae and adult beetles are ferocious predators on many different caterpillars and will climb trees to get at the Southwestern Tent Caterpillars.



Pupae



Adult

Seasonal development of the caterpillars may vary from year to year, but generally follows the same plan. The larval stage may last from mid-March through mid-May, then essentially all of the larvae enter the pupal stage. The pupa is a silken case, about ½ inch long, that may be hidden under bark or logs or in crevices, including rock and brick crevices. The pupa may cause an allergic reaction if handled by allergy sufferers or individuals with very sensitive skin. The adult emerges through a hole in the pupa case. The bricks around our shuttle stops and buildings are major sites for pupae. Pupal sites may also include tents, trailers, and vehicles, all of which may contribute to distributing this insect into new areas. Some predators, such as birds and lizards, may break in to pupa cases and eat the developing insects. Pupation typically lasts about two weeks but may last longer. Adults emerge in late May and are active for a few weeks into June or July.

In 1970, a paper was published on this species (Baker, B.H. 1970. Occurrence of *Malacosoma incurvum discoloratum* in Zion Canyon, Utah. Pan-Pacific Entomologist 46: 27-33.). That paper goes into detail about the species and its biology in Zion National Park. Tent Caterpillars were considered a nuisance in the campground and other heavily used recreational areas, and the NPS attempted to control them using several different kinds of insecticides over the years.

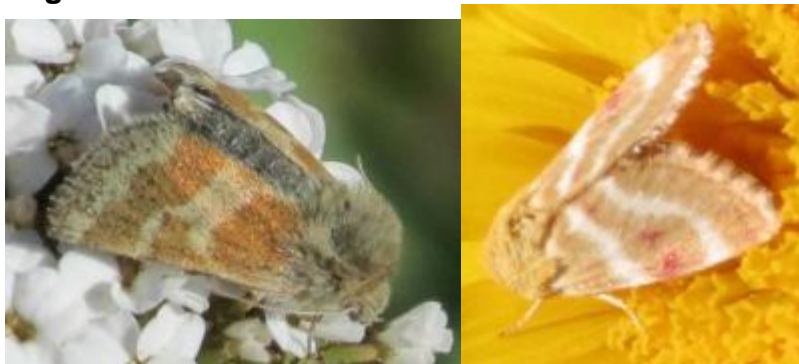
OWLET MOTHS (FAMILY NOCTUIDAE)



This is the largest family of moths, with more than 2,500 species known from the U.S. Unfortunately, identification of species can be extremely difficult without good specimens and many species are very similar to each other. These are often common moths, most are little brownish fuzzies, but some can be quite colorful and some can be quite large. Most members of the family can be identified as Noctuidae by the way they hold their wings when at rest, giving them a distinctive shape. The upper wings are generally brownish, grayish, or whitish, although some can be pink, and camouflage the moth on its chosen resting surface. The lower wings are often contrasting with the colors and patterns of the uppers, but are usually difficult to see when the moth is at rest.

Some species may be quite numerous at times, and some are considered pest species on agricultural crops and in gardens as larvae. Some species may feed on flowers in the daylight. Because adults may come to lights in great numbers, they may be annoying, especially at night or when they get into buildings. They are harmless, but may cause problems at large astronomical telescopes, where their scales can get on exposed mirrors and lenses. The first known computer “bug” was a Noctuid moth that got into a computer and caused electronic problems when it was electrocuted.

Flower Moths – genus *Schinia*



These pretty creatures are often seen abroad in daylight, resting or feeding, or laying eggs in flowers. There are about 120 species in the genus in the U.S. They vary greatly in color and size, with some being pink and others mostly brown.

MANTISES AND COCKROACHES (SUPER ORDER DICTYOPTERA)

Some books and some taxonomists combine these obviously related creatures into one order, Dictyoptera, and others split them into two: Mantodea and Blattodea.

MANTISES (ORDER MANTODEA)



Mantodea includes the praying mantises, which are popular with gardeners for their reputed pest control abilities. They are, in fact, generalist predators and would just as soon catch a pollinator or another predator as a pest insect. The general term for these insects has been expressed both as “praying” mantis, for the posture of the front limbs resembling a prayerful posture, and as “preying” mantis for the feeding behavior.

Mating takes place over a period of several hours. The mating pair shown above had been at it

for at least three hours before they were photographed. The oft-repeated story that the female always eats the male after or during mating is probably not the rule. In captivity with no place for the male to run, that may be the case. After mating, the most likely scenario is that the male will run or fly away, leaving the slower-moving female to lay her eggs.



Eggs are deposited in an egg mass that looks, at first, like white foam. It hardens to brownish over time. The egg masses are usually built on upward trending twigs, mostly bare of leaves. The young overwinter in the egg case, and then hatch in the spring with voracious appetites. They run down the twig that was their birthplace, and if any encounter each other, they will probably try to consume each other. Egg cases are frequently parasitized by tiny wasps that lay their eggs in the foam before it hardens. Limited information is available on how this happens, but at least in some species the female wasps use their strong hind legs to grasp on to the wing of a female mantis and let her carry them around. At least some wasps bite off their own wings after they find (somehow) a mantis, then become dependent on the mantis for transportation. When the mantis lays her eggs, the wasp jumps off and lays her own eggs in the egg case. The larval wasps consume the developing mantis embryos, pupate, and emerge through tiny round holes in the sides of the egg case at about the same time the baby mantises emerge or sometimes several days before. An amazing video of the emergence is available at: <https://www.youtube.com/watch?v=03JABZtAZ1c>. Mantises emerge from the “front” side of the case, through a uniform row of holes that appears to be somehow built in to the case. Wasps emerge from round holes in the side that appear to be more or less randomly located. More than one wasp may use the same hole for emergence.

It takes most of a summer of feeding for our large mantises to mature, and they probably consume several hundred or more other insects. Mantises may be different colors to blend with their background. Some species may be able to change colors when they molt. They usually feed by sitting and waiting for a prey insect to approach, then grabbing the prey with the raptorial front legs and biting through vital organs. Apparently, mantises do not discriminate between potential prey items, but grab anything that come close enough and seems reasonable in size. Some species are known to even catch mice and lizards, but I have not seen this.

There are about 20 North American species, and several that have been introduced. The only mantises observed or collected in Zion National Park so far are in the genus *Stagmomantis* but the species has not been determined. It is possible that we have several species and more than one genus.



ROACHES (ORDER BLATTODEA)

Cockroaches are probably the most reviled of insects. People tend to be afraid of these generally harmless creatures. There are about 68 native North American cockroaches and a dozen or so non-natives that have become established on this continent. In many species, only the males have wings. They are attracted by pheromones the wingless females secrete, and fly to them at night when they are less likely to be caught by birds.

The only native roach known from Zion National Park is the Field Cockroach (*Blatella vaga*). It looks very much like the introduced German Cockroach (*B. germanica*) which is actually from northern Africa. The introduced species is considered the worst household pest. It is possible that the German Cockroach is present indoors here, because some individuals that look like young ones have been caught in the Museum. Without adults, though, we cannot tell for sure. The introduced Oriental Cockroach (*Blatta orientalis*) has been collected in the Park, including in the Museum. Another introduced species, the Turkestan Roach (*Shelfordella lateralis*), can be found outdoors. I found several of them in the Administration Building parking lot one night, congregating under a large spreading Coyote Gourd (*Cucurbita foetidissima*) and photographed them when they came out onto the curb. Most of our non-native roaches are essentially indoors pests and are dependent upon the conditions we provide for them. They consume crumbs at the table (and under it) and book bindings. In the Museum, they may damage specimens of plants and animals and historic artifacts.

There may be other native and non-native species present. It is not possible to distinguish most roaches without examination of specimens.



Male



Female

LACEWINGS AND THEIR RELATIVES (ORDER NEUROPTERA)



Members of this order are “nerve-winged” insects. The name refers to the netlike pattern of wing veins that is characteristic of all members of this order. These are not nerves, but bracing support structures that give the wings strength while keeping weight down. Most of these creatures are not strong fliers, but use their wings only to disperse from their larval habitats and get to new territory to reproduce. Many species are nocturnal and come to lights, getting trapped in the campground restrooms.

Most species in this order are voracious predators on other insects. The basic life story is that eggs are deposited in a safe place that is likely to provide food for larvae. The larvae hatch and are predators on insects in their specific habitats. They catch their prey either by just grabbing them or by making traps and hiding in wait. Pupation occurs in the larval habitat, or mature larvae may migrate from their habitats, e.g., water, to other habitats, e.g. under a log or rock away from water. The pupal stage may be brief or may be the overwintering stage, depending on the season at which the larva matures. Members of this order range in size from barely visible to among our largest insects. There are 15 families and 349 species of Neuroptera in North America. The most familiar and likely to be seen are Antlions, Dobsonflies, and Green Lacewings.

ANTLIONS (FAMILY MYRMELEONTIDAE)



These creatures are most often recognized by their larval homes, which are conical pits in sand, especially in shady places. The pits are traps, carefully constructed from loose sand. Ants, walking along the edge of the pit, will tumble down on the loose sand to the bottom of the pit. There the sharp, venomous jaws of the larva protrude upward from the larva's hiding place. If the ant succeeds in a self-arrest of its fall, the larva will hurl sand at it to knock it down to the bottom. If the pit is unsuccessful or is damaged, the larva will move to a new site. It walks backwards, leaving a trail in the sand that gives the creature the name "doodlebug." The genus *Myrmeleon* includes seven North American species. The species from Zion National Park have not been identified, but there may be more than one. Only members of this genus build the conical pits. There are several other genera that may be present that do not build pits, but forage in tree holes, animal burrows, or leaf litter. Adults are nocturnal, but are not attracted to lights.

DOBSONFLIES AND FISHFLIES (FAMILY CORYDALIDAE)



Adult female



Remains of empty egg cases

These are the nightmare monsters of the insect world. Larvae are huge aquatic predators that look like centipedes and are called “hellgrammites” by anglers who use them for bait. Larvae live in the river and feed on insects, tadpoles, and fish. It takes about a year for one to grow from egg to maturity, depending on water temperature. In colder areas of the country, it may take two or three years. Wandering larvae may be found along the Pa’rus trail or Riverside Walk or near the Virgin River where they are probably looking for a good site to hole up for the pupal stage buried in mud or a rotting log.

Adults emerge in late spring or summer. They either do not feed or sip a bit of nectar, but mostly they are interested in mating and laying eggs. Mating usually takes place on the ground, rocks, or vegetation. Adults may come to lights at night, so may be found in the campground and housing areas. Male Dobsonflies (*Corydalis cognata*) are some five inches long and have massive jaws that are completely harmless but scary looking. Males die within a day or so after mating. Females lack the huge jaws, but are capable of giving a nasty pinch with their smaller jaws. Each female may produce between 1000 and 3000 eggs, and live for a week or longer.

Eggs are generally stuck to the underside of rocks or tree branches that overhang the water. Several females may choose the same site to lay eggs. Each female may lay about 1,000 eggs in a cluster of several layers. She then covers the cluster with a liquid that dries to make a tough white protective shield. In a week or two, larvae hatch, break through the covering, and drop into the water. They float along in the river until they come to an area with many rocks and well oxygenated water, then bury themselves beneath the mud or sand under the rocks.

Some entomologists classify these creatures as a separate order Megaloptera.

GREEN LACEWINGS (FAMILY CHRYSOPIDAE).



These delicate-looking insects are abundant and major predators on aphids and other soft-bodied plant feeding insects. They blend in with their leafy environments, but can occasionally be seen flying or coming to lights at night.

Green lacewings lay their eggs on leaves, placing each egg at the tip of a silken stalk. This placement helps prevent predation of the eggs, especially by young lacewings that are hungry when they hatch and will eat anything they can overpower, including their brothers and sisters. The larvae walk about on leaves, munching aphids as they go. I have watched them feeding at the rate of about one aphid a minute.

When they mature, the larvae spin little silken cocoons in which they pupate. When they emerge, they fly about in search of aphids and mates.

The name *Chrysopa* means “golden eyes” and many but not all species have brilliant golden eyes in the adult form. There are several genera and about 16 species in the U.S.

ORDER ODONATA : DRAGONFLIES AND DAMSELFLIES



This order consists of insects that spend their larval lives in water and their adult lives mostly in the air or on perches near water. Collectively, they are informally called “odonates.” The eggs are laid either directly in water or on or in plants growing in or close to water. The eggs hatch into larvae that are spectacularly camouflaged ferocious predators with grasping fangs on extensible lower lips. After several months to several years in water, larvae emerge, split the exoskeleton down the center of the back, and out comes the adult. Adults mate on the wing, the males clasping the females by the neck and flying about in tandem. Some may also remain in tandem while the female lays eggs; others will have the male guarding the female, preventing her from mating with another male while she lays eggs that he has fertilized. Although they are mostly associated with water, adult dragonflies may fly far from water. Dragonflies and damselflies are harmless to people, although some can give a good pinch if they are handled.

There are several distinct families of odonates, but all have the following characteristics in common:

- Huge eyes
- Abdomen long and narrow
- At rest, they hang vertically or perch horizontally
- Legs that form a basket for grasping insect prey
- Larvae are aquatic predators.

Dragonflies have wings that stick out at the sides and do not fold across the back or stand above the body, and their hindwings are broader at the bases than the forewings. The larvae of dragonflies have internal gills and take water into their bodies through a multifunctional posterior opening. Damselflies are more slender and delicate than dragonflies, tend to not fly as far or fast, and their forewings and hindwings are about the same shape and narrow at the bases.

Damselfly larvae have external gills that trail behind them. There are about 300 species of dragonflies and 130 species of damselflies in North America.

The website: <http://www.npwrc.usgs.gov/resource/distr/insects/dfly/chklist/chklist.htm> leads to a checklist of species known from Washington County, Utah, but it does not include all of the species previously documented at Zion National Park. There are undoubtedly many more species in the county, but they are not included on this site yet.

The following websites offer useful information and photos:

<http://azodes.org/> probably has most, if not all, of the species likely to occur in Utah, although the site's focus is Arizona.

<http://www.odonatacentral.org/>

http://www.wildutah.us/index_dragon.html

Also the following books may be helpful:

Common Dragonflies of the Southwest by Kathy Biggs

Dragonflies through Binoculars by Sidney W. Dunkle

Zion National Park offers a considerable variety of aquatic and aerial habitats for odonates. However, Odonates are fairly rare in this environment most of the time, at least as larvae. One possibility is that our aquatic environments vary so much throughout the year, some drying entirely, others flash flooding at several orders of magnitude above base flow that it is very difficult of larval odonates to survive. Many dragonflies migrate, and so may come here as adults but not reproduce successfully here. Some frequent the river corridor, some the smaller tributary creeks and others are found in the potholes in slickrock. Others may use all available aquatic habitats, and may even mistake the hood of a vehicle for a place to lay eggs. Some adults fly in the wide open spaces, while others zip along narrow stream corridors or over the river, and some seem to think paved roads are good places to forage for insects. Once in a while you might notice swarms of dragonflies that may number several hundred individuals. These are "static feeding swarms," composed of individuals that have encountered swarms of tiny flies and are feasting on them. The phenomenon is temporary but may recur at the same or a nearby site on a few days, then disappear. If you see one, or would like to know more about the phenomenon, go to <http://thedragonflywoman.com/dsp/> and report what you have seen to contribute your observations to an ongoing research project.

The list of species documented from Zion National Park is probably not complete, and further research is likely to find several more that are not listed here. The following species are among the most common and conspicuous in Zion National Park.

DRAGONFLIES (FAMILY LIBELLULIDAE)
Flame Skimmer (*Libellula saturata*)



This large, colorful dragonfly may be our most common and conspicuous member of this order. It can be found almost anywhere along the Virgin River and its tributaries, including small potholes in the slickrock community and at Emerald Pools. It lays its eggs, however, only in relatively still waters, such as the Emerald Pools and permanent potholes. It is easily recognized by the bright orange color of its body and the extent of orange on its wings.

The larvae are beautifully camouflaged aquatic predators that often hide partially beneath stones and other aquatic structure and dart out in pursuit of prey. The extensible lower lip is almost as long as the rest of the insect and has grasping fangs on its end, which is toothed and shaped like a scoop—very effective for capturing prey.

Red Rock Skimmer (*Paltothermis lineatipes*)



This colorful creature usually perches on rocks, and may sit still for minutes at a time before darting off after potential prey. Females are gray and blend well with rocks. The best place to find them is in the reach of Pine Creek upstream from the Highway9 bridge.

NARROW-WINGED DAMSELFLIES (FAMILY COENAGRIONIDAE)



Members of this family tend to rest with their wings folded over the body and the body held horizontally. Many are quite colorful, mostly black marked with blue, but they are variable and difficult to distinguish from each other. There are 92 species in 14 genera in the U.S., but 67 species belong to two genera: 30 in *Argia*, most of which frequent streams, and 37 in *Enallagma* which tend to frequent ponds. At least three species of *Argia* have been identified in Zion National Park. Adults are predators on flying insects that are caught by grabbing with the front legs.



Adults fly slowly and often in tandem. Females are less colorful than males. When damselflies mate, the male clutches the female tightly and flies with her to a good spot to deposit their eggs. Mating is a fairly complicated arrangement. The male stores his sperm in a special pocket on the underside of his thorax. The female, held by her neck, arches around to make contact with the male's sperm pocket, then stretches out to lay her fertilized eggs in emergent

vegetation or directly into water. They fly about in tandem until either they get disturbed or run out of sperm or eggs. Often several pairs will be depositing eggs in almost the same place—apparently, really good sites are not common.



Larvae are slender, camouflaged, and breathe through three gills that extend from the posterior. They are ferocious predators on smaller aquatic insects. They can be easily observed walking about on the bottom of the stream pools below Weeping Rock, the Emerald Pools and in some of the larger potholes in the slickrock.



When the larvae are mature, they climb out of the water, usually grasping a twig or piece of emergent vegetation. The larval skin splits and the adult insect emerges. It has transformed from a drab, camouflaged, water-breathing creature to a colorful, winged, air breather, and left the old, empty skin behind.

SPREADWINGS (FAMILY LESTIDAE)



Our largest damselflies, the spreadwings can be seen most often flying along quiet reaches of small streams or resting on vegetation, especially young willows close to the water. Most likely to be seen along Birch Creek or at the Swamp area along the Riverside Walk. We may have several species, easily identifiable to “spreadwing” but more difficult to identify to species.

BROAD-WINGED DAMSELFLIES (FAMILY CALOPTERYGIDAE) **American Rubyspot (*Hetaerina americana*)**



Easily identified by the brilliant ruby spot on the wings, if you get a good look, these damselflies may be found along the small tributaries and quieter reaches of the Virgin, where some emergent vegetation grows. Probably the best site for watching them is the swamp area of the Riverside Walk.

GRASSHOPPERS, CRICKETS, AND KATYDIDS (ORDER: ORTHOPTERA)



Insects in this order have straight wings (*ortho*= straight, as in orthodontist). The straight wings are only the front pair, which serve primarily as camouflage and are held outward during flight. The second pair of wings is membranous, may be transparent or very startlingly colorful, and is folded beneath the first pair when not in use. Some members of this order do not have wings, or their wings may be reduced. Because this order has incomplete metamorphosis, young ones somewhat resemble adults, but their wings are not functional. Other general characteristics of this order are:

- Hind legs long and/or modified for jumping
- Cerci (appendages at tip of abdomen) unsegmented
- Pronotum (thorax armor) usually with large descending lobes on sides
- Hind coxae (part of the legs closest to the body) small and well-separated
- Hind tibiae (lower legs) with two dorsal rows of teeth
- Chewing mouthparts.

At least 26,000 species are known, but there are probably more. For lots of information about the Orthoptera, consult the website:

<http://orthoptera.speciesfile.org/HomePage/Orthoptera/HomePage.aspx> The website : <http://entomology.ifas.ufl.edu/walker/buzz/> has songs of North American singing insects.

Capinera, J. L., R. D. Scott, and T.J. Walker. *Field guide to Grasshoppers, Katydid, and Crickets of the United States* is the first (and only) such guide and may be helpful.

GROUSE LOCUSTS (FAMILY TETRIGIDAE)
Toltecan Grouse Locust (*Paratettix toltecus*).



These creatures are also called Pygmy Grasshoppers for their diminutive size, which seldom exceeds a centimeter. They look a lot like large pebbles. The top of the thorax extends over the length of the abdomen; and the front wings are reduced to flaps. The hind wings are folded under the projection. They live in muddy places and feed on algae or small plants. Taxonomy is reputed to be very difficult. 29 species are known from North America. In 1929, O. Wilford Olsen, of the Department of Zoology and Entomology of Brigham Young University, published a paper: Notes on the Tetriginae of Utah (*Pan-Pacific Entomologist* Vol. 5, 181-182). This was a summary of species primarily collected by Vasco M. Tanner. It includes one species from Zion National Park: Toltecan Grouse Locust (*Paratettix toltecus*).

This pair may be that species. They were together on a rock on the edge of Birch Creek, where there was plenty of algae.

SHORT-HORNED GRASSHOPPERS (FAMILY ACRIDIDAE)

This family includes most of the species of grasshoppers in North America (620 species), and all (so far) that are documented from Zion National Park. It consists of most of the critters one might recognize as grasshoppers. A few of those known to occur in Zion are described below.

Grasshoppers and Orthoptera in general, are well known for their sound-producing behavior. Sound production and display flights in grasshoppers are behaviors associated with mating and territoriality. Grasshoppers do not sing or chirp like crickets and katydids because they do not have a file and scraper mechanism on their wings. Grasshoppers produce sound by two mechanisms called stridulation and crepitation. Stridulation occurs when a grasshopper rubs the insides of the hind legs against the abdomen or wings to produce a scraping or chirping sound; most grasshoppers produce sound by this method. Crepitation is sound produced by rapidly flexing the hind wings in flight producing crackling and snapping. Crepitation is limited to the band-winged (Subfamily Oedipodinae) and a few slant-faced (Subfamily Gomphocerinae) grasshoppers. Stridulation and crepitation sounds differ among different species, and like bird calls, can be used to identify different species of grasshoppers.

Spurthroated Grasshoppers (subfamily Cyrtacanthacridinae, Genus *Melanoplus*)



The name Spurthroated Grasshopper refers to a pointed growth on the underside of the grasshopper's "neck" in the area between the forelegs, which is a muscle attachment point. All members of the subfamily have this feature, and clear, unmarked wings. The genus *Melanoplus* includes over 200 species, most of which are difficult to distinguish from each other. The number of species in Zion National Park is not currently known, but there are undoubtedly several. Almost all *Melanoplus* have the black marks from eyes to wings. Males and females may be different colors, and males are usually smaller than females. Some species of *Melanoplus* are major agricultural pests, and one species that was historically a pest is now apparently extinct. Adults are generally about an inch long, and have two conspicuous black marks extending from eyes to wings. Some species may be quite colorful, others rather plain. *Melanoplus* are found in most of the United States except Florida and the southern portion of the other states on the Gulf of Mexico and coastal Oregon and Washington. They occupy a variety of habitats, including meadows, prairies, crop fields, and old fields.

Green Bird Grasshopper (*Schistocerca shoshone*).



This common late summer grasshopper can be found at all elevations in Zion National Park. It may be most abundant in areas with tall forbs or shrubs, on which it hides and feeds. It also comes to lights at night, so it can be found along the lighted walkways near the Visitor Center and the Human History Museum as well as in the campgrounds. This species is found throughout most of the western U.S., often in riparian areas where its color blends well with vegetation. It can get to be up to about four inches long (females are larger than males). The genus *Schistocerca* has ten North American species and one (*S. gregaria*) that occurs in the Old World and is responsible for the enormous locust plagues that strike portions of Africa occasionally. The Green Bird Grasshopper is not one of the migratory species, but spends most of its life in a small area. Even though it has the ability to fly long distances (for a grasshopper), it usually spends all of its life close to where it hatched.



Band-winged Grasshopper (subfamily Oedipodinae)

Grasshoppers in this subfamily usually are well camouflaged by their front wings. If flushed, the grasshopper reveals its hind wings, which are marked by black bands that contrast with a base color of red, orange, yellow, blue, or green. The general color of the creature, though, blends well with the ground on which it dwells, and the bright color is usually only seen when the grasshopper flies. When it lands, the color disappears and the insect is camouflaged again. This is probably an excellent defense against hungry birds and people who try to catch grasshoppers.

Pallidwinged Grasshopper (*Trimerotropis pallidipennis*).



This common grasshopper looks like a line of pebbles until it flies, flashing its pale yellow wings bordered with black. The Pallidwinged Grasshopper ranges from southwestern Canada to Argentina, making it the most widely distributed grasshopper in the New World. It is typically a western rangeland and desert species. Vegetation of habitats consists of shrubs, forbs, and grasses with a preponderance of bare ground on which these grasshoppers commonly bask and rest. Outside their usual rangeland habitats, Pallidwinged Grasshoppers find favorable environmental conditions in weedy city lots, old fields, parking lots, sidewalks, and trails. This species can have tremendous outbreaks, with numbers reported as high as 50 to 100 per square yard. They are attracted to lights, and in 1998, an outbreak in Arizona resulted in accumulations of grasshoppers up to a depth of two inches on streets and highways.

The Pallidwinged Grasshopper belongs to the diverse band-winged genus *Trimerotropis* which has more than 40 described species and several yet undescribed. The large number of species with many shared color patterns and structural characteristics present a challenge for accurate identification. (See the next species for one that stands out as different.)

The Pallidwinged Grasshopper hatches early in spring from eggs that have overwintered in the soil. The adult stage of the Pallidwinged Grasshopper is reached in mid to late spring. Males make frequent short flights in which they crepitate (snapping sounds produced by the hind wings). This apparently attracts females and begins courtship. Upon landing, the male walks in a straight line to a resting female if one is nearby. Further courtship consists of stridulation, which sounds like trilling to the human ear. One to eight trills in quick succession are produced by males advancing toward females. A receptive female remains still as the male approaches and mates with her. The eggs are laid in bare soil to a depth of approximately 1 inch, in an egg pod

that is slightly curved, narrow (1/8 inch in diameter), and 1 inch long, with an average of 34 pale yellow eggs, 4.5 to 5 mm long.

Bluewinged Grasshopper (*Trimerotropis cyaneipennis*).



This grasshopper looks almost exactly like the previous species until it flies. Then it flashes its blue wings, and gives away its identity. It blends in extremely well with the red rocks and soil, and remains motionless until practically stepped on. Apparently, the Bluewinged Grasshopper is more common at higher elevations than its pallid winged cousin. We found it abundant in the Kolob Section of Zion National Park in August.

Redwinged Grasshopper (*Arphia pseudonietana*).



The Redwinged Grasshopper is a large, dark brown to black, darkly speckled grasshopper, with the front wings colored like the body. It is practically invisible when at rest on bare ground, but when flying its red wings flash. The Redwinged Grasshopper ranges widely in North America occupying grass and grass-shrub habitats. In Zion National Park, it is most abundant in the Pinyon-Juniper zone and above. The Redwinged Grasshopper is a minor pest in western grasslands because it feeds on a variety of valuable forage grasses and sedges, but because of low numbers it causes no serious losses.

It is a strong flier, and may crepitate as it flies in a zigzagging, undulating flight. Then, it

completely disappears when it lands. On warm, sunny days, the Redwinged Grasshopper makes many voluntary flights. Although most flights are in a straight line, some males fly nearly straight up to a height of approximately four feet, and then flutter down slowly with their wings flashing brilliantly red in the sunlight. When they reach the vegetation canopy, they close their wings and drop to the ground. The performance is accompanied by a loud crackling crepitation. These flights function to bring pairs together for courtship and mating. Females lay their eggs in pods of approximately 25 to 30 eggs, buried in bare soil. The pods are nearly straight and 1 5/8 inches long. Young Redwinged Grasshoppers hatch in May or June, and adults are found in late summer through the first frost.

Carolina Grasshopper (*Dissosteira carolina*).



The Carolina Grasshopper, one of North America's largest grasshoppers, is a conspicuous species because of its size, colorful wings, and habit of flying over dirt roads and other bare ground. It may reach a length of three inches and is brown with black hind wings bordered by yellow. It is widely distributed in North America, inhabiting weedy grasslands. It is a minor pest of rangeland grasses and occasionally has been a crop pest. Populations occur chiefly in disturbed areas where it feeds mainly on several species of forbs and grasses. Ingested weeds include Russian thistle (tumbleweed).

During warm sunny days, the adults move from vegetated to bare areas such as dirt roads and slickrock areas where they fly about and become highly conspicuous. Males have a hovering flight, rising almost vertically to heights of 3 to 6 feet and hovering for 5 to 15 seconds, then fluttering down to the ground close to where they started. During the hovering flight, they produce a soft, sibilant sound. The hovering behavior appears to attract females and other males so that a small aggregation of several males and a female may gather on the bare ground beneath the hovering male. In ordinary flight, Carolina Grasshoppers may fly a distance of 2 to 36 feet at heights of usually 1 to 2 feet. They undulate and may crepitate as they fly. If flushed by a person,

however, they may fly 70 feet or more at 1 to 5 feet high and make a right angle turn at some distance into the flight before landing on the ground.

The males court females by producing a calling signal using their hind legs and wings to stridulate. One hind leg at a time is rubbed against the wing in a behavior called alternate stridulation. A male sits horizontally on bare ground in sunlight and may continue to call for 5 minutes or longer until he attracts a female. She walks toward him, and when she is close, he approaches her and mounts. If he is successful, the pair mates. They may remain in tandem for as long as 16 hours. The female lays her eggs in compact bare ground exposed to the sun, often at the edge of a gravel or dirt road or trail. She works her ovipositor to a depth of 1 1/2 inches and deposits a large clutch of eggs that she encloses in a sharply curved pod that is nearly two inches long and usually contains more than 40 eggs.

KATYDIDS (FAMILY TETTIGONIIDAE)

The species in this family are very difficult to distinguish from each other. Most sing at night, and they have different songs. The website: <http://entomology.ifas.ufl.edu/walker/buzz/> has recordings of some of the songs of Katydids. The insect collection from Zion National Park has very few specimens in this family, and there are probably more to be found.

Greater Angle-wing Katydid (*Microcentrum rhombifolium*).



This insect looks like a green leaf. It is found almost everywhere throughout the U.S., wherever there are deciduous trees. Eggs are laid in an overlapping row on twigs, where they spend the winter. Young katydids do not sing and are scarcely ever seen. Adults have wings and will come to lights at night. The songs are distinctive.

TRUE CRICKETS (FAMILY GRYLLIDAE)

Tree Cricket (*Oecanthus* sp.).



These delicate insects are extremely well camouflaged on the trees and shrubs on which they live. This genus has at least 16 species that closely resemble each other. We do not know the identity of the one or more species found in Zion National Park. Tree crickets are predators on aphids and also eat some leaves and fruits. They lay their eggs in growing twigs. Males sing by rubbing their wings together, as is characteristic of the family. The song is rather ventriloqual, and the insects go quiet when approached by something person-sized. They may come to lights at night. They are rather strictly nocturnal and hide by day on the undersides of leaves or deep inside flowers. This one has found a *Datura* flower in which to hide.

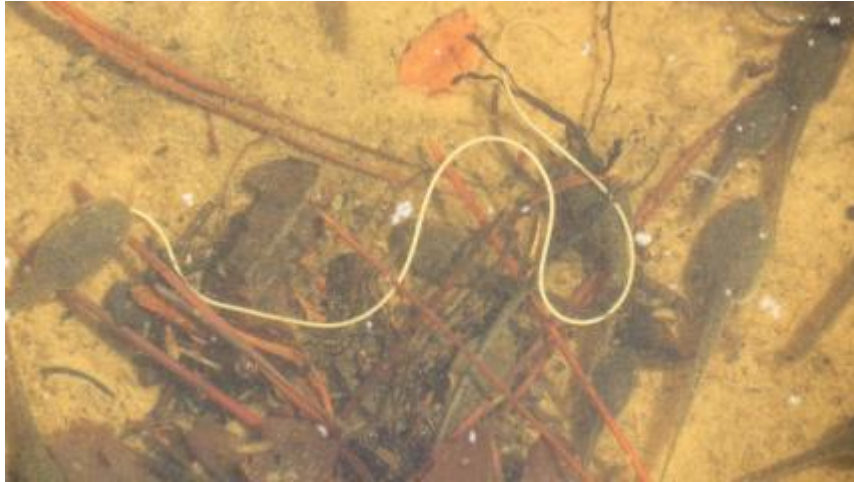
JERUSALEM CRICKET (FAMILY STENOPELMATIDAE)



Stenopelmatus fuscus has been identified from Zion National Park but the genus is in need of revision and ours may turn out to be a different species. There are somewhere between 20 and 60 species in the U.S. This very strange looking insect lives mostly in burrows in loose soil or hides under rocks or logs. Many people are frightened by these creatures, which they believe to be poisonous. They are, in fact, quite harmless but can pinch if handled. In Zion National Park, they can be found from the valley floor to the highest plateaus. These crickets never grow wings. They are active at night, and are thought to be predatory on other insects and to feed on roots and

decaying vegetation.

Jerusalem Crickets (and other crickets) are known to carry a parasitic horsehair worm, also called a Gordian Worm (Phylum Nematomorpha), which may be over a foot long. The adult worms live in water, especially still water such as in potholes in slickrock and backwaters of small streams. Eggs are consumed by the cricket, hatch, and grow into mature worms. The worms somehow make the crickets seek out water and jump in; the crickets drown and the worms burst out to live in their adult habitat. Horsehair worms may be a meter long—much longer than the cricket hosts. If you see a Jerusalem Cricket dead in water, look for the worm.



STICK INSECTS (ORDER PHASMATODEA)

WALKINGSTICK (FAMILY HETEROMIIDAE)



These amazing creatures appear to be quite rare in Zion National Park, as I have only seen one in the seven summers that I have worked here. It is included here only because it is likely to arouse the interest of anyone who sees one. A generally harmless creature, it is a strict vegetarian. However, some species in this Order defend themselves by a chemical spray that can cause severe eye irritation, so it is not a good idea to mess with them. It has no wings, but relies on camouflage to protect it from predators. It moves very slowly and is usually to be found only on vegetation, but can be conspicuous if it comes onto a rock. There are four species in three genera in Utah. This is one of the two species in the genus *Parabacillus*

ABOUT THE AUTHOR



Ken Kingsley is a naturalist who mostly works as a volunteer for the National Park Service. He has a Ph.D. in Entomology and Ecology from the University of Arizona, a M.S. degree from the University of Nevada, and a B.A. from Prescott College. For most of his career, he worked as a consultant, conducting surveys and developing protection plans for threatened and endangered species. He delights in going for adventures and sharing his appreciation for nature with people, especially children. He is married to Amy Gaiennie, a professional interpretive ranger for the National Park Service, who took some of the photos in this guide and edited it.