



Life in a Colorado Water Garden



The Insects and Other Invertebrates Associated with Water Features



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Background of this Project

Establishment of and involvement with water garden features has become much more popular in Colorado in recent years. With the increasing experience of water gardeners many yards have created miniature ecosystems that, in addition to the plant life, also attract and support myriad insects, crustaceans and other invertebrates.



Very few of these organisms pose any harm to the plants of the water garden. Yet existing books on water gardening, when they do mention insects at all, emphasize only those that may feed on plants, the “pests”. This project instead sought to document and record all the life forms found in regional water gardens so that water gardeners may better understand them – and perhaps better appreciate them.

Most of the observations for this project were made during the summer of 2007, in cooperation with several members of the Colorado Water Garden Society and the Denver Botanic Garden. Cyndie Thomas and Greg Walker were most heavily involved in the collection of samples, including much of the photography associated with this project. Boris Kondratieff, the aquatic insect “czar” at Colorado State University, was the primary technical resource. Overall project coordination and writing was done primarily by Whitney Cranshaw, also of Colorado State University, with help from all of the above.

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Whitney Cranshaw
January 2010



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Invertebrate Life in a Colorado Water Garden Feature – The Feeding Guilds

An established water garden will support a great many different invertebrates each with their own food habits and ecological roles. A small number feed on higher plants, including the few that are sometimes considered to be pests. The majority are scavengers feeding on bottom sediments or decayed plant material while others may filter small particles and microorganisms from the water. At the top of the food web are the predators, most visibly the dragonflies and damselflies that possess immature stages that develop underwater. Various transient species may visit ponds to drink or collect water for nest construction and maintenance.

Herbivores feed on live plants. *Piercer-herbivores* feed with piercing mouthparts and suck plant sap. Aphids are the most common representatives in a water garden with this habit. *Chewer-herbivores* consume whole pieces of plant material cut with chewing mouthparts and include various grasshoppers or caterpillars such as the China mark moth that are adapted to water garden plants.

Shredders feed by chewing on dead plant matter or damaged areas of leaves. Leaves may be skeletonized, with the softer tissues between veins removed. The amphipods and ostracods primarily feed by shredding. Snails, notably the physid snails, may feed by shredding.

Scrapers graze upon and shear off the film of bacteria, algae and associated organic particles that cover the surface of submerged objects. Most snails are scrapers, as are small minnow mayflies and the amphipods.

Collector-gatherers vacuum or pull into their mouth the small pieces of organic matter that settle at the bottom of the pond. These include the most abundant invertebrates found in water gardens and include most chironomid midges, the aquatic earthworms, planorbid snails, and water boatmen. Some species, such as the amphipods and small minnow mayflies, may share this habit with some grazing.

Collector-filterers filter suspended organic material from the water column. Mosquito larvae continuously collect such material as they swim about through the water. Other insects attach to a solid surface in areas of flowing water and filter out small organic matter particles and microorganisms that pass by. Larvae of black flies, mosquitoes and net-spinner caddisflies are insects with this habit.

Predators capture and ingest animals. Some ingest their prey with chewing mouthparts, a habit of the top invertebrate predators found in ponds - the damselflies and dragonflies. Others feed with mouthparts designed to pierce and suck the blood of prey, a habit common among the predatory Hemiptera, such as the backswimmers and water striders. Leeches also suck blood from various insects and other aquatic invertebrates.

Plant Feeding Species



Waterlily aphids. Photograph by Cyndie Thomas.

Waterlily Aphid

Hemiptera: Aphididae

Species Name: *Rhopalosiphum nymphaeae*

Appearance: Waterlily aphid varies from olive green to golden brown. All appendages are dusky, excepting the tip of the cornicles.

Life History and Habits: Waterlily aphids suck sap from plants. They can

develop on a wide range of host plants that includes: *Nuphar* (pond lily), *Numphoides* (floating heart), *Ranunculus* (buttercup), *Sagittaria* (arrowhead), *Typha latifolia* (common cattail), *Veronica* (speedwell), *Cicuta douglasi* (western waterhemlock), *Berula erecta* (stalky berula), *Polygonum* (knotweed), *Ceratophyllum* (hornwort), and *Leersia oryzoides* (rice cutgrass). Where it undergoes a holocyclic life cycle, overwintering stages and spring generations occur on plums (*Prunus* spp.)

Two life history patterns may occur. A life cycle where the aphids are continuously associated with water garden plants (anholocyclic) occurs indoors and predominates outdoors where pond temperatures allow for year-round presence of living host plants. Populations are comprised solely of females that give live birth to genetically identical offspring. Winged forms may be produced that allow dispersal, but wingless adult forms are primarily produced. Reproduction occurs year round, with length of life cycle dependent on temperature.



Waterlily aphids

The holocyclic life cycle occurs outdoors as a means to survive cold winters when living host plants are not present. Life cycle is similar to the above during the main growing season.

However, late in summer and early fall special winged forms are produced that disperse to certain woody plants in the genus *Prunus*, primarily, if not exclusively, certain plums.

Winged males are present during one generation cycle at this time and a special sexual form female is produced, allowing one generation of sexual reproduction. The subsequent progeny are egg producing females that lay eggs near the buds of the winter host plant (*Prunus*). Eggs remain dormant during winter and hatch following spring bud break. A couple of generations occur on the new growth of this plant before winged

females are produced that disperse to summer hosts (e.g., *Nuphar*, *Typha*).



Waterlily aphid “mummies”, parasitized by *Aphidius* sp. wasps

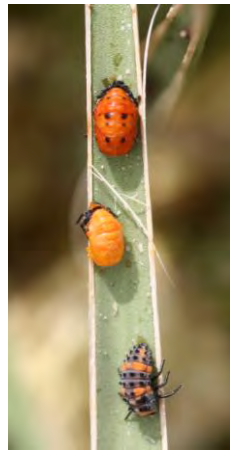
Associated Species: Several natural enemies prey on waterlily aphid. Tiny parasitic wasps in the genus *Aphidius* that develop as internal parasites cause aphids to appear bloated and lighter in color. Adults and larvae of lady beetles will commonly be found among aphid colonies as will larvae of syrphid (flower) flies.

Control: Waterlily aphids are easily washed off plants with a jet of water. If there are top feeding minnows (e.g., *Gambusia*) the aphids may be eaten when in the water.

Favorable Water Garden Features: Host plants must be present. This insect is likely to be more common if plants are maintained at the site over winter in warmed areas, allowing foliage to be present that supports survival on plants. The local presence of wild plum and other *Prunus* species that support the overwintering egg stages may also contribute to the occurrence of this insect at a pond in late spring.



Lady beetle larvae



Lady beetle pupae (top) and prepupa (bottom)



Flower fly (syrphid fly) larva feeding on aphids

Oleander Aphid/Yellow Milkweed Aphid

Hemiptera: Aphididae

Species Name: *Aphis nerii*, possibly related species

Appearance: Milkweed aphids are bright yellow or yellow-orange. Many of the appendages are tipped with black.

Life History and Habits: The milkweed aphid most commonly develops on plants in the milkweed family, with swamp milkweed, *Asclepias incarnata*, a host plant found in water

gardens. Oleander and Vinca are among the other plants that may host this insect.

This species does not have winter hosts, but continuously develops on living plants, sucking sap in a manner common to other aphids. However, because of this habit milkweed aphids fail to



Yellow milkweed aphids. Three parasitized aphids are at the right of the picture.

survive winters if host plants are killed. It is considered only marginally adapted to areas such as Colorado and likely only survive in highly protected sites. New infestations can arise from migrant aphids or introduction of infested plants.

Associated Species: Various predators, notably lady beetles and larvae of flower flies (syrphid flies), help control milkweed aphids. They are also commonly parasitized by tiny wasps, that cause the aphids to bloat and discolor as conspicuous “aphid mummies”.

Favorable Water Garden Features: Host plants must be present. This insect is likely to be more common if plants are maintained at the site so that they remain alive in warmed areas.

China Mark Moth

Lepidoptera: Crambidae

Species Name: *Nymphuliella daeckalis*

Appearance: Larvae are green caterpillars that feed on leaves of water lily. Older larvae are always found in a shelter of two cut leaf pieces that they carry with them and that allows them to float. Because of this practice of living within the leaf pieces the caterpillars are often referred to as “sandwich men” or “taco men”.

Wings of the adult moth are orange-brown with mottling and wings are held at rest so that they form a “V”. (This is a feature that is also shared by a great many other insects found around area yards, such as the alfalfa webworm.)



Caterpillar of the China mark moth exposed from leaf “sandwich”. Photograph by Cyndie Thomas.

Life History and Habits: The China mark moth has several unusual habits that allow it to develop on aquatic plants. Winter is spent as a partially grown caterpillar attached to underwater stems of water lilies. It is protected by a shelter it constructs of two leaf fragments, held together by silk. It resumes activity in spring when new growth of water lilies is produced and then

moves to the underside of leaves.

Initial feeding injuries cause skeletonizing, where the larvae feed between the larger leaf veins producing lacy patches. Later they cause more generalized feeding, chewing irregular areas from the edges of leaves. Sometimes late stage caterpillars will pull two leaves together and feed between the leaves. Tunneling of the petiole has also been observed.

Apparently all species of water lily (*Nymphaoides*) are suitable hosts of the China mark moth. However, cultivars with thinner leaves are favored and more seriously damaged.

Throughout its development the caterpillars remain within a case of leaf pieces. As they get older, larger pieces are used. This unique habit provides them protection and allows them to float. Movement from plant to plant occurs as breezes and current carry them along on this “boat”.

When larvae are full grown they pupate within the leaf shelter. A couple of weeks later adults emerge. Females lay eggs in small groups along the edge of leaves.

The China mark moth can complete three generations under Maryland conditions. In Colorado it rarely survives winters except under high protected conditions and infestations originate from introduction of infested plant material.

Favorable Water Garden Features: Host plants must be present. This insect is likely to be more common if plants are maintained at the site allowing overwintering in warmed areas.



Circular leaf cuts typical of the China mark moth caterpillar. Photograph by Cyndie Thomas.



China mark moth adult water lily damaged by the caterpillar stage. Photograph by Stanton Gill, University of Maryland.

Saltmarsh Caterpillar

Lepidoptera: Noctuidae (Arctiinae)

Species Name: *Estigmene acrea*

Appearance: Larvae are very hairy caterpillars but can vary considerably in coloration. Younger stages tend to be more yellowish while older caterpillars are usually reddish-brown or nearly black. The adult is a white moth, although the underwings may be yellow.

Life History and Habits: Saltmarsh caterpillar is a generalist feeder that may feed on a very wide range of plants, occasionally damaging crops and gardens.

Winter is spent as a full-grown larva within a cocoon among leaves and other sheltering debris. Pupation occurs the following year and the adult moths emerge in late spring. Females lay eggs in masses and initially the caterpillars feed in a loose group. As they get older they disperse and may wander considerable distances. Probably two generations are normally produced annually in Colorado, the second generation producing caterpillars that may be present in late August and September.



Saltmarsh caterpillar damaging water lily. Photograph by Bob Hammon.

Aquatic Leaf Beetles

Coleoptera: Chrysomelidae

Species Present: *Donacia* spp., *Plateumaris* spp.

Appearance: Larval stages associated with plants are cream-colored grubs. There is a distinct brown head capsule and three pairs of legs occur on the thorax. No legs are found on the abdomen. Adults are metallic colored beetles about 1/4 to 3/8 inch long with an elongated body form and long antennae.

Life History and Habits: Several species of beetles in the genera *Donacia* and *Plateumaris* are native to North America. All develop entirely in water and each species feeds on one or more specific kinds of aquatic plants.

Eggs are laid in a variety of manners. Some glue eggs in masses on submerged parts of



Donacia sp. leaf beetle larva exposed at the base of a water lily. Photograph by Cyndie Thomas.

plants. A few insert eggs into leaf pieces that they fold together and glue; others chew pits in the undersurface of leaf and insert eggs. Eggs are covered with a gelatinous material.

Upon egg hatch larvae migrate to the roots and corms of host plants where most development occurs. Some will also feed for a period on leaves, chewing small holes. However, when nearing maturity they return to the base of plants where they pupate. The pupal stage can last for nearly a year and the life cycle likely requires two years to complete. Adults are winged and can disperse from the pond where they may be found at flowers, later returning to lay eggs.

The ability of larvae and pupae to remain submerged is due, in part, to their ability to penetrate into the air spaces within aquatic plants, using specialized structures on the hind end. They may also be able to absorb oxygen directly through their skin. Adults have hairs on the body (plastron) that can trap air bubbles, allowing them to remain submerged for long periods.



Adults of *Donacia* sp. aquatic leaf beetles

Favorable Water Garden Features:

Although some aquatic beetles do occur in Colorado, they are uncommon and found only near permanent ponds. The presence of these insects within a water garden will likely be due to introducing infested plant material from southern areas. They may persist and develop within water gardens if the appropriate plants are present and ponds are not periodically drained.

Differential Grasshopper

Orthoptera: Acrididae

Species Name: *Melanoplus differentialis*

Appearance: The differential grasshopper is one of the larger grasshopper species found in the region. Usually they are generally yellow and brown, with distinctive black herring-bone patterns on the jumping legs.

Life History and Habits: Typical of most regional grasshoppers winter is spent in the egg stage, in the form of a pod of a few dozen eggs. The egg pods are laid in summer and early fall in loose, dry, undisturbed soil. Eggs hatch the following spring and the grasshoppers take about



Differential grasshopper, mating pair

6-8 weeks to become full-grown. Adult stages may persist until the frosts.

Over 100 species of grasshoppers occur in Colorado but the differential grasshopper is one that is well adapted to garden conditions and is usually the species most likely to be found damaging water garden plants. A related species, the two-striped grasshopper (*Melanoplus bivittatus*), also is a common grasshopper of regional gardens. The redlegged grasshopper, *Melanoplus femurrubrum*, is also a common grasshopper that tends to occur in sites of higher moisture.

Surface Active Insects

Water Striders

Hemiptera: Gerridae

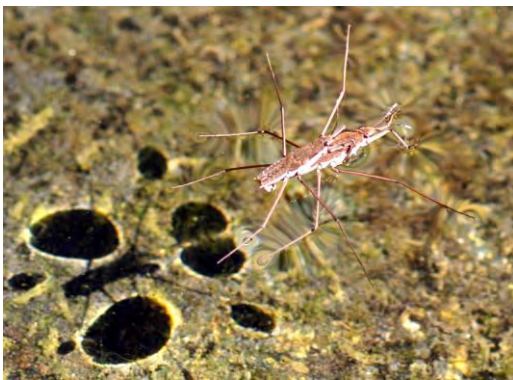
Species Present: *Gerris (=Aquarius) remigus* and perhaps others

Appearance: Water striders are distinctive insects with the hind two pairs of legs extremely elongated and which allow skating on the water surface. The front pair of legs are considerably smaller, but designed to grasp small insects. The body form is elongate and most are generally brownish. Winged and wingless forms may be produced.



Water strider

Life History and Habits: Water striders are predators of other insects and suck fluids from prey with piercing-sucking mouthparts. Most often prey are small insects trapped on the water surface which they detect from vibrations. Recently dead insects may be eaten and occasionally they will be cannibalistic.



Water strider mating pair

Water striders spend the winter under leaves and other protective cover, flying back to ponds in spring. Eggs are laid just under the water surface, usually attached to plants along the edge of the pond. Immature stages resemble miniature adults. Development to the adult stage typically requires a month to a month and a half with multiple generations annually produced. Adult forms can vary with both wingless and winged forms.

The ability of water striders to skate across the water surface is due to hydrophobic hairs that tip the legs. Locomotion is primarily effected by the middle pair of legs, used in a rowing motion.

Water striders are capable of diving for brief periods, and will carry a bubble of air trapped next to the body with fine hairs.

Favorable Water Garden Features: Water striders can occur in almost any still pool but will be more common in larger ponds.

Broadshouldered Water Striders

Hemiptera: Veliidae

Species Present: *Microvelia* spp.

Appearance: Broad-shouldered water striders are very similar to the water striders in most features but are smaller and heavier bodied.

Life History and Habits: Broad-shouldered water striders are predators of small insects, insect eggs and other arthropods that occur on or just below the water surface. They use piercing-sucking mouthparts to feed on body fluids of their prey. They are most active in small still pools along the edge of ponds. Often they crawl across floating plants and occasionally forage along the shore.

Winter is spent under vegetation along the edge of the water. Upon emergence they lay eggs on plants and other objects. Upon egg hatch the tiny nymphs begin to forage for food and become full grown in about a month. Multiple generations occur during the warm months. Adults are capable fliers and can readily colonize new ponds.

Favorable Water Garden Features: Broad-shouldered water striders prefer still pools with much surface vegetation along the edge.



Broadshouldered water strider (upper left) on water lily with physid snail and water lily aphids.

Active Swimmers

Water Boatman

Hemiptera: Corixidae

Species Present: *Sigara alternata* primarily

Appearance: Generally brown, with the hind pair of legs broadened in a oar-shape to allow swimming. When observed they are often hanging downwards in the water.



Water boatman.

Life History and Habits: Adult water boatmen are strong fliers and may colonize a water garden pond almost anytime during the warm seasons. They feed on living material that they stir up on the bottom with their front legs and scoop into their mouthparts. This can include a wide variety of materials including diatoms, protozoa, algae, and small insects.

Eggs are usually laid on plants. The developing nymphs generally resemble the adults, but are smaller and wingless, feed in the same manner. A generation can be completed in about 5 to 7 weeks and multiple generations occur during the year. During winter adults of some species burrow into the bottom and go dormant. Others may continue to be active throughout the winter, even under the ice.

Water boatmen can remain underwater for long periods by carrying an air bubble on their underside, which covers their spiracles. This functions as a gill, allowing some additional oxygen from the water to replenish the bubble. The insects periodically return to the surface to renew the air bubble but can stay underwater for hours.

Favorable Water Garden Features: Adults are excellent fliers and readily disperse great distances so water boatmen may be found in almost any pool of relatively still water. They will do best in ponds that have allowed the various small plants and animals on which they feed to become established. Koi may feed on these insects.

Backswimmers

Hemiptera: Notonectidae

Species Present: *Notonecta kirbyi*, *N. undulata*

Appearance: Backswimmers possess hind legs adapted for swimming, which are typically angled forward when at rest. Coloration of backswimmers is reversed from water boatmen since they swim upside down; the back is light colored and the underside dark.

Life History and Habits: Backswimmers are predators of insects, other arthropods and even occasionally tiny fish. They capture prey by grabbing it with their spiny front two pairs of legs then piercing with a beak-like mouthpart that injects a paralyzing saliva. The saliva also helps to digest the prey and they then feed by sucking back the fluids.



Backswimmer at surface. Photograph courtesy Ken Gray Collection, Oregon State University.

Backswimmers survive winter in the adult stage. Eggs are glued to plants and other underwater surfaces in spring and early summer. Immature stages are also predators, generally resembling tiny adults. They can become full grown in about 2-3 months and one generation is produced per year.

To allow breathing underwater backswimmers carry a bubble of air along the underside of the body and, in adults, underneath the wings.

This can allow extended periods underwater as dissolved oxygen from the water moves into bubble and replenishes. A quick trip to the surface, with the tip of the abdomen break the surface, allows them to acquire a new air bubble. They may remain submerged for hours following a trip to the surface.

Favorable Water Garden Features: Adults are excellent fliers. They usually can be found in ponds with relatively still waters, not areas with high water flow. They are more likely to occur in ponds that are well established and support animal life on which they feed. Koi may feed on backswimmers.

Mosquitoes

Diptera: Culicidae

Species Present: *Culex* spp. predominantly

Appearance: Mosquito larvae, commonly known as “wigglers”, are elongate in form with an enlarged area behind the head.. They actively move through the water with active twisting motion. Pupae, known as “tumblers” have a more compact body for and similarly may move through the water.

Life History and Habits: *Culex* species mosquitoes are the most common types that breed in permanent waters. Winter is spent in the adult stage, in protected sites around the



Mosquito larvae (“wigglers”).



Mosquito pupae (“tumblers”).

yard and sometimes within buildings. During this time they are semi-dormant (diapause) and do not feed, but resume activity in spring.

Females suck blood, usually feeding at night and produce a high pitched whine as they fly. Birds are almost exclusively the host, but humans are also occasionally fed upon. Male mosquitoes feed on nectar and other fluids, and are not blood feeders. Large plume-like antennae on the males can distinguish the sexes.



Culex pipiens laying egg mass on water surface. Photograph courtesy of Susan Ellis.

Eggs are laid directly on the surface of water, as masses in the form of small rafts. Eggs hatch within a few days and the larvae develop in water. Mosquito larvae are active insects known as “wrigglers” and feed on small particles of organic matter that they comb out of the water. Depending on temperature they complete development within a couple of weeks and transform to the pupal stage. Mosquito pupae, known as “tumblers”, are mobile as well. Adults emerge from the pupae onto the water surface and fly away.

Favorable Water Garden Features: *Culex* mosquitoes prefer still pools with some organic debris. They survive poorly in water with fish that prey on them. The mosquito fish *Gambusia* is sometimes introduced to kill mosquito larvae and similar top-feeding minnows will prey

heavily on mosquitoes. Koi will have limited effectiveness for mosquito control. Mosquitoes can also be controlled through use of *Bacillus thuringiensis* var. *israelensis* (Bti), a biological insecticide that is introduced into water. It is commonly sold in the form of granules or doughnut-shaped “dunks”.



Some Bti mosquito larval control products.

Mosquitoes should be managed in water garden features. The primary mosquito species that are present in water gardens (*Culex* spp.) are the local vectors of West Nile virus.



Filter Feeders in Flowing Water

Black Flies

Diptera: Simuliidae

Species Present: *Simulium decorum* and other *Simulium* spp.

Appearance: Immature stages are attached to the upperside and sides of rocks or submerged vegetation. Larvae are hot-dog shaped with a bluntly rounded hind end tipped with tiny hooks. Pupal stages occur within a slipper-shaped protective cover and have prominently protruding branched gills. Adults are small, humpbacked dark colored flies about 1/16-inch in size.

Life History and Habits: All immature stages occur in flowing water only where larval and pupal stages attach to rocks or other solid surfaces. Larvae are firmly attached by tiny hooks at the tip of the abdomen; pupa are attached within a slipper-shaped silk cocoon. Larvae feed by use of fan-like mouthparts designed to filter out small organic matter particles in the water.



Black fly larvae on underside of rock in stream feature.



Black fly larvae (center) and pupae (on either side within slipper-like case) attached to a rock.

Adults emerge from the pupa and are carried to the surface on a small air bubble. Adult females feed on blood; males feed on nectar. Although some species of blackflies are notorious biting pests affecting humans, the species found in Denver area water gardens (e.g., *Simulium decorum*) limits feeding to birds. Females lay eggs as tiny gelatinous masses on the water. Multiple generations can be produced during the summer.

Favorable Water Garden Features: Clear, running water flowing over rocks, plants and other surfaces that allow larvae to attach.

Net-Spinner Caddisflies

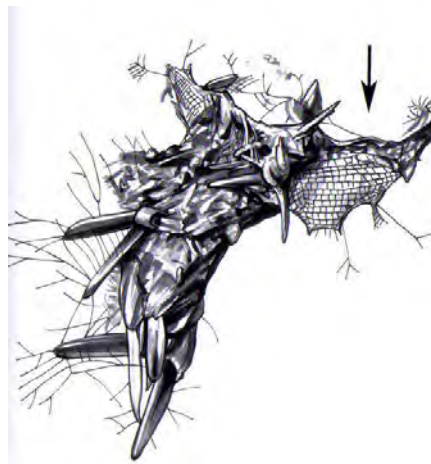
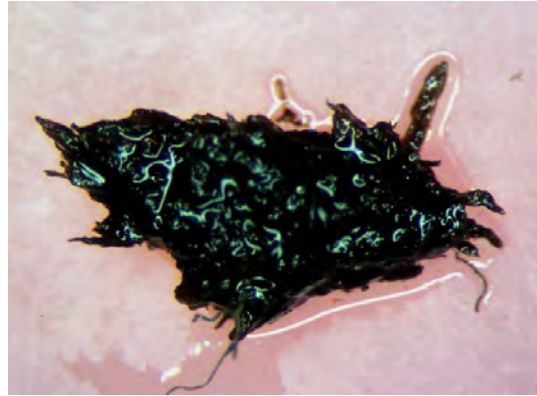
Trichoptera: Hydropsychidae

Species Present: *Cheumatopsyche analis*, perhaps others

Appearance: Caddisfly larvae found in water gardens construct a loose silken retreat that is covered with fine particles of sand and debris. However, they will often leave the retreat if disturbed. They are elongate in body form with a dark head and prominent legs. The abdomen and much of the thorax, which normally are protected within the retreat, are dull-green colored.

Life History and Habits: Net-spinner caddisfly larvae live within a “retreat” they construct and attach to rocks or other solid surfaces. It is loosely held together with silk and composed of pieces of plant matter and other debris. At the opening a silken net catches small organisms and bits of organic matter on which the larvae feed. When full-grown the larvae construct a pupal chamber and pupate. Adult stages subsequently emerge and are winged insects that may fly considerable distances. Mated females dive into the water to lay eggs in small gelatinous masses. One generation is usually produced annually.

Favorable Water Garden Features: Water flow and long-term permanence of the water feature is required to allow caddisfly colonization.



Net-spinner caddisfly larval case (above). A diagram of the net-spinner caddisfly case, indicating the silk net used to gather food. Illustration from *A Field Guide to Freshwater Invertebrates of North America*.

Collectors and Grazers on Bottom Sediments and Surfaces

Small Minnow Mayflies

Ephemeroptera: Baetidae

Species Present: *Baetis tricaudatus* (flowing water), *Callibaetis* spp. (standing water)

Appearance: Larvae have a bullet-shaped form and 3 long tails. Gill plates are present along the sides of the abdomen.

Life History and Habits: The most common species winter as larvae, swimming about on the bottom of ponds. They feed by vacuuming small organic particles and scraping algae and other microorganisms from the surface of rocks and plants.

When full grown they move to the surface and a winged stage (subimago or dun) emerges through a split along the back. These fly to nearby vegetation and are usually grayish.

Usually within a couple of days a second

winged form emerges from the subimago form, producing the ultimate adult form (imago or spinner). Mating occurs within the next day and females drop eggs into water. Neither of the adult forms feed.



Adult female mayfly (*Callibaetis* sp.) in the dun stage. Photograph by Cyndie Thomas.



Nymph of a *Callibaetis* sp. mayfly.



Baetis tricaudatus nymphs under rock in stream feature.

Multiple generations of *Callibaetis* species may occur during a year.

Favorable Water Garden Features: All mayflies require water that well-saturated with oxygen and relatively few will be found in water gardens. *Callibaetis* spp. are the mayflies most commonly found and are adaptable to ponds with growing plants. *Baetis tricaudatus* was observed in a stream feature site with continuously moving water. Mayflies are more likely to find and colonize a water garden if lakes or streams are nearby.

Chironomid (Non-biting) Midges

Diptera: Chironomidae

Species Present: *Tanytarsus* spp., *Cricotopus* spp., *Chironomus* spp., *Procladius* sp., others

Appearance: Adults are similar in general body form to mosquitoes, with which they are commonly confused. Larvae are usually pale-colored and worm-like, often found in a loosely constructed silken tube. Some species, known as “blood-red midges”, are bright red due to the presence of hemoglobin that allows them to live in oxygen poor sites

Life History and Habits: Chironomid midges are almost invariably the most abundant insect found associated with water gardens. They are a diverse insect family with numerous species and a range of a habits.

Larvae of most species feed by filtering fine organic matter particles that are suspended in the water or by gathering the material that has settled on the bottom of the pond and on surfaces of plants and rocks.

The common chironomid midges found in water gardens live within open-ended tubes of loose silk. These often are attached to plants or other solid surfaces. Others lay on or are shallowly buried in bottom sediments. Movements of the body cause water to flow by the larvae and oxygen moves directly through the thin body wall of the larvae. One group of chironomid



Silt covered tubes of chironomid midge larvae on a rock.



Chironomid midge larva. Photograph by Cyndie Thomas.



Blood red midge.

midges, known as the „blood red“ midges, are among the few insects that have hemoglobin in their blood and are among the most tolerant insects of low oxygen-containing waters.

Adult midges are delicate flies commonly mistaken for mosquitoes. Many species will produce conspicuous mating swarms. These typically contain almost only males, with the occasional female darting into it periodically. Swarming by the chironomid midges often occurs over conspicuous landmarks in the yard, typically light colored. Several generations are produced each year.

Favorable Water Garden Features: Chironomid midges will be found in almost any pond that is established long enough to provide the small pieces of decaying plant matter and associated microorganisms on which they feed. They can be most common on the bottom of still ponds, but can occur in areas with moderate water flow.



Adult chironomid midge. Photograph by Cyndie Thomas.



Chironomid midge adults may form “top swarms” that aggregate over tall vegetation or other prominent points in a landscape.

Drone Flies/Rattailed Maggots

Diptera: Syrphidae

Species Present: *Eristalis tenax* and related species (Tribe Eristalini of the family Syrphidae)

Appearance: Larvae are legless maggots with a uniquely elongated „tail“. Adults mimic bees and some very closely resemble honey bees and are called „drone flies“.

Life History and Habits: Larvae develop in shallow areas at the edge of pools, breathing through an opening at the tip of the siphon tube that extends from the abdomen. They feed on soft, partially decayed organic matter. Because of their ability to breathe at the surface through the telescoped spiracle they can live in stagnant, oxygen-poor areas of mud and decomposing plant matter not suitable for other insects. Pupation also occurs in the water.



Rattailed maggots develop in oxygen poor pools, breathing through a spiracle at the tip of the “tail”. Photograph by Cyndie Thomas.

Adults leave the ponds and are most commonly seen at flowers, where they feed on nectar. This habit is shared by other members of the Syrphidae family, which are sometimes known as „flower flies“. Almost all of the syrphid flies resemble various bees or wasps but adults of the rat-tailed maggots have a particularly strong resemblance to a male honey bee (drone). Despite

their mimicry to stinging insects, syrphid flies are harmless.

The complete life cycle time likely requires a year or more to complete. Overwintering stage may be as larvae or pupae.

Favorable Water Garden Features: Stagnant shallow pools rich in decaying plant matter or moist decaying plant matter along edges of pools.



A drone fly, *Eristalis* species. These flies are excellent mimics of bees.

Ostracods/Seed Shrimp

Crustacea: Class Ostracoda

Species Present: Unknown

Appearance: Minute (less than 1 mm), somewhat resembling a small clam.

Life History and Habits: Active swimmers, often found along the edges of the pool. Active swimmers - tiny legs. They feed by grazing on algae and other microorganisms but also shred dead plant matter. They will commonly skeletonize fallen leaves, feeding on the softer tissues between veins. Their occurrence in dead stems may mimic injuries sometimes thought to be caused by fish feeding.



Ostracods skeletonizing decaying leaf. Photograph by Cyndie Thomas.

Favorable Water Garden Features: Ostracods will probably do well in shallow, still pools. Their presence in a water garden will occur from incidental introduction or plants or by some other movement by humans or water fowl.

Amphipods/Scuds

Crustacea: Order Amphipoda

Species Present: *Hyallela azteca* (a species complex)

Appearance: The common amphipod in ponds somewhat resembles a tiny shrimp, about 1/10-inch long. They are cream colored or a light gray/brown. Numerous legs and antennae project from the body.

Life History and Habits: Amphipods chew on small particles of organic debris and microorganisms that they sweep into their mouth. They may also graze on films of algae and bacteria. They are active swimmers, characteristically swimming on their side and are sometimes called "sideswimmers" or "scuds". Most often they occur near the bottom of shallow water, particularly among tangles of plant stems.

Most reproduction occurs in spring and a one year life cycle is typical.

Favorable Water Garden Features: Amphipods need permanent water to survive between seasons, but are quite adaptable to pond conditions. They are introduced into water gardens by people incidentally with plant materials and visiting waterfowl may also carry them.



Hyallela azteca, a common amphipod found in water bodies throughout North America. Photograph courtesy Scott Bauer, USDA-ARS.

Aquatic Earthworms

Annelida: Class Oligochaeta

Species Present: Undetermined

Appearance: The earthworms adapted to aquatic life are similar in general features to the commonly encountered terrestrial earthworms - elongated, legless with soft, segmented bodies.

Life History and Habits: Aquatic earthworms ingest the soft debris that falls to the bottom of ponds. Most burrow through the soft sediment as they search for food, incidentally helping to mix sediments in a manner similar to the soil mixing function of terrestrial species. Others live in vertical mud tubes, with their rear end



Aquatic earthworms in mat of algae. Photograph by Cyndie Thomas.

protruding and waving. Small pellets present on the surface of the pond indicate their activities.

The aquatic earthworms are very tolerant of low oxygen concentrations and can be very abundant in small, stagnant pools where decaying plant matter is abundant. Similar to terrestrial earthworms they are hermaphrodites, but can not self-fertilize. Reproduction can also occur asexually by budding of certain cells in the „budding zone“ of the body.

To allow survival through adverse periods of drying or unfavorable temperatures they may tightly coil and cover themselves in thick mucous producing a resistant cyst.

Favorable Water Garden Features: Aquatic earthworms require a moderate accumulation of bottom sediments. Their presence in the pond requires incidental transfer by humans, typically on plants.



A planorbid snail.

Planorbid Snails

Class Gastropoda: Family Planorbidae

Species Present: Undetermined

Appearance: Planorbid snails have a coiled shell that remains flat, rather than tapering into a spiral.

Life History and Habits: Planorbid snails feed by collecting decaying plant matter. They are most commonly seen on the bottom of ponds among the silt.



Snail egg masses. Photograph by Cyndie Thomas.

Favorable Water Garden Features: Planorbid snails require permanent water with some bottom sediments. Koi will actively feed on snails.

Physid (Paper) Snails

Class Gastropoda: Family Physidae

Species Present: *Physa* spp.

Appearance: Physid snails have a coiled, tapering shell with the opening on the left when the narrow end is up. They are sometimes referred to as “paper snails” because the shell may be quite thin.

Life History and Habits: Physid snails feed on dead plant matter or scrape surfaces for algae and other organisms. Incidentally they may occasionally

damage plant leaves, an injury most commonly observed on lily pads. Their eggs, produced in jelly masses, are commonly observed attached to plants and they appear to preferentially lay eggs on senescing leaves that will subsequently be fed upon by the young snails.

Favorable Water Garden Features: These snails are commonly moved incidentally with transfers of water plants and adapt well to water gardens. The presence of submerged objects that support algal growth and decaying vegetation provides adequate food. Koi will actively feed on snails.



Koi will feed on many snails



Physid ("paper") snails and egg masses.
Photograph by Cyndie Thomas.

Lymnaeid Snails

Class Gastropoda: Family Lymnaeidae

Species Present: Undetermined

Appearance: Lymnaeid snails have a spiraled, elongated tapering shell with the opening on the right when the narrow end is up. They are sometimes referred to as "pond snails" because the shell may be quite thin.

Life History and Habits: Lymnaeid snails feed on scrape surfaces for algae and other organisms and may incidentally old, senescing leaves accelerating decay. They are most commonly found on solid surfaces such as rocks, plants, and sunken containers.

Favorable Water Garden Features: These snails are commonly moved incidentally with transfers of water plants. Koi will feed on them.



Lymnaeid snail. Image from
*A Guide to Common
Freshwater Invertebrates of
North America.*

Predators Hunting at the Bottom of Ponds

Pond Damsels/Narrow-winged Damselflies

Odonata: Coenagrionidae

Species Present: *Enallagma* spp., *Ischnura* spp., *Argia* spp. (transient adults only)

Appearance: Pond damsels are highly elongated insects, about 2-3 inches long with a very thin abdomen. They have long, delicate wings that are held together vertically above the body when at rest. Color is variable but the more common species are primarily blue, gray or black.

Immature stages are elongate and have 3 long plate-like gills protruding from the hind end. The head is blunt and, like all members of this order, the lower jaw (labium) is extensible and is used to capture prey.

Life History and Habits: Winter is spent in the larval stage in ponds. The larvae are predators of small insects and other arthropods that they grab with their extensible lower jaw. Most species crawl about for prey, searching amongst underwater plants and other submerged debris. When full grown they crawl to the edge of water or onto surface plants and later the adult emerges from the larval skin.



Pond damsel nymph. Photograph by Cyndie Thomas.



Pond damsel (*Enallagma* sp.) mating pair in the "wheel position".

Adults usually remain near water and are predators of small flying insects that they capture in flight. When mating they engage in the unique behavior found in other damselflies and dragonflies. The male transfers sperm to a special pouch on the second segment of the abdomen. After locating a receptive female he grasps her behind the head with a pair of specialized claspers. The female then curls her abdomen to contact the sperm pouch for egg fertilization ("wheel position").

After mating the male typically continues to clasp the female and they fly in tandem, a practice that prevents subsequent mating. Eggs are laid in plant tissues below the water surface. During egg laying the female may completely submerge as she climbs down the plants for egg laying. Typically one generation is produced per year.

Favorable Water Garden Features: Emergent vegetation is required for egg laying and developing stages require submerged vegetation for areas to hunt. Plants with succulent stems (e.g., *Polygonum*, *Lotus*) are more suitable for egg

laying than plants with tougher surfaces (rushes, grasses, cattails).

Ponds that are maintained with water between seasons can allow larvae to survive between seasons and help develop populations of prey insects.



Nymph of a pond damsel.

Spreadwinged Damsels

Odonata: Lestidae

Species Present: *Archilestes grandis*

Appearance: Spreadwinged damsels have a similar body shape to narrow-winged damsels but are slightly larger. The wings when at rest are held outwards at a 45° angle, more in the manner of dragonflies. Immature stages share similar features with the more common pond damselflies but have an extremely narrow body very long, stalked eversible lower jaw.

Life History and Habits: Larvae are active hunters that crawl on underwater plants and other debris in search of prey. Overwintering in backyard ponds may be in the egg stage within plants. Adult spreadwinged damsels insert eggs into plant stems above the water surface. These eggs can survive in a dormant stage within the plant and thus can survive in temporary ponds that periodically dry out. All spread-winged damsels produce only a single generation a per year.



Nymph of the spreadwinged damselfly, *Archilestes grandis*.



The spreadwinged damselfly *Archilestes grandis*.

Favorable Water Garden Features:

Emergent vegetation is required for egg laying and developing stages require submerged vegetation for areas to hunt. They will be found in deeper pools. Because of their ability to lay dormant eggs in vegetation they can survive in ponds that are drained.

Meadowhawks/Skimmers

Odonata: Libellulidae

Species Present: *Sympetrum pallipes* (striped meadowhawk), *S. occidentale* (western meadowhawk), others

Appearance: Larvae are cryptically colored with dappled greens and browns. As with all dragonflies they lack the external tail-like gills of damselfly larvae.

Life History and Habits: Larvae are predators of insects and other small animals. They hunt by ambush, as „sprawlers“ lying in wait on the bottom of ponds, often near the base of plants. When larvae are full grown they crawl up plants or onto the edges of the pond and the adult form emerges.



Mating pair of meadowhawks.



Nymph of a skimmer dragonfly.

Adults lay eggs by dropping them on the water surface, often near bunches of plants. There is one generation produced per year with adults becoming most common in late summer and early fall.

Favorable Water Garden Features: The nymphs of meadowhawks require permanent pools that have developed adequate populations of prey and provide some collection of sediment and debris on the bottom.

Mosaic Darners

Odonata: Aeshnidae

Species Present: *Aeshna palmata* (paddle-tailed darner), *A. umbrosa* (shadow darner), others

Appearance: Larvae have a streamlined body striped or spotted with green and brown. Adults are large dragonflies with bluish eyes and a mosaic pattern of stripes or



Female shadow dancer. Photograph by David Leatherman.

spots on the abdomen.

Life History and Habits: Larvae are predators of insects, other arthropods and even small fish. They are climbers that search for prey among the tangles of plant stems and dead plants. They typically have a life cycle that extends for more than year, although it may be completed in a single year with warm temperatures and abundant prey. Adults commonly stay near ponds patrolling along the edges, defending territories and searching for mates and prey. However, they are strong fliers and those found near ponds may easily be migrants.

Favorable Water Garden Features: Ponds must be permanent to support the long life cycle and adequate submerged vegetation must be present to provide areas for larvae to hunt.



Nymphal skin of a damselfly nymph left after adult emergence.

Leeches

Annelida: Class Hirudinea

Species Present: Undetermined. There are approximately 65 North American species of leeches and they are very difficult to distinguish.

Appearance: Leeches are generally flattened with numerous segments. The head end is tapered. Most have a general tan or dark brown color but many have patterning that may be bright. Size varies most encountered in backyard ponds reaching about one inch.

Life History and Habits: The various leech species have a range of habits but all suck fluids of animals. Most are predators of insect larvae, earthworms and other invertebrates and these likely make up the great majority of those found in ponds. A few kinds of leeches develop as external parasites of birds, turtles, fish and occasionally other animals.

Leeches typically crawl by use of two suckers located on the underside of the body. When crawling they move inchworm-like alternating attachment with the front and hind suckers. Some leeches are free swimmers, undulating through the water.



Leeches. Photograph by Cyndie Thomas.

Most leeches mate in spring and lay eggs in cocoons in the mud or along the shoreline. They can be long lived with those kept in captivity sometimes surviving 10-15 years.

Favorable Water Garden Features: Leeches can be found in a wide variety of habitats, although they rarely occur in silty bottoms where it is difficult for them to attach. Many are quite tolerant of low oxygen content.

Planaria

Platyhelminthes: Class Turbellaria

Species Present: *Dugesia dorotocephala*

Appearance: Small, dark flattened worms with an elongate body tapered at both ends.

Life History and Habits: Planaria primarily feed on small invertebrates or scavenge dead animal matter. In search of food they move slowly, gliding over rocks. Reproduction can be either sexual or by asexual division.

Favorable Water Garden Features: Usually found at sites with water gently flowing over rocks or other solid surfaces.



Planaria. Image from *A Guide to Common Freshwater Invertebrates of North America*.

Visitors to the Pond Edge

Several kinds of arthropods frequently visit the edges of backyard ponds. Some come to collect water, others materials to help with nest construction or maintenance. Because of the abundant insect life emerging from the water it can also be a productive hunting ground for predators.



Honey bee collecting water at pond edge.

Honey bees (*Apis mellifera*) will visit pond areas to collect water. This is returned to the hive where it can have several functions. During hot weather water is used for cooling the hive, an effect produced by the bees actively evaporating the water through wing fanning. Water is sometimes needed to help dissolve honey, particularly if it has crystallized. Salts in water also are apparently sometimes sought by honey bees.

Polistes paper wasps (*Polistes dominula* and relatives) collect water to help in nest construction. These insects make nests of paper, produced from grinding wood fibers. The water is needed to mix with the wood pulp, creating the paste that is formed into nest cells. Like honey bees, these wasps may also use water to cool the hive during hot weather.

Paper wasps may also search ponds for food. These insects are predators of insects, primarily caterpillars, and may explore plants for insect prey.

Yellowjackets (*Vespula* spp.) also make nests of paper, although nesting by these insects usually occurs below ground. Visits to the edges of ponds are usually to collect water needed in nest construction, similar to the paper wasps.

Feeding habits of yellowjackets vary. The common Colorado species is the western yellowjacket, *Vespula pensylvanica*, a notorious scavenger that sometimes deters outdoor dining in late summer. It may visit



Two species of paper wasps (*Polistes* spp.) searching water garden plants for prey.

ponds to scavenge dead insects or other dead animals (e.g., worms, snails) and will collect the sticky, sweet honeydew that is excreted by aphids. On the other hand, the most common

yellowjacket seen cruising about ponds in Colorado is the prairie yellowjacket, *Vespula atripilosa*, which feeds on living insects, similar to the paper wasps.

Potter wasps or eumenid wasps (*Euodynerus* spp. primarily) create individual nest cells of mud or use mud to create and ultimately seal nest cells created by tunneling. These cells are later packed with paralyzed insects it captures and the young feed on this cached prey. Potter wasps visit pond edges to collect mud used for nest construction.



Black and yellow mud dauber collecting mud for nest construction.

The black and yellow mud dauber (*Sceliphron caementarium*) similarly constructs nest of mud cells, with nests commonly seen in corners of outbuildings or under eaves. Mud daubers visit pond edges to collect mud. These insects also are hunting wasps and the adult female captures and paralyzes spiders, which it uses to provision the nest cells.



Longjawed orbweaver spider.

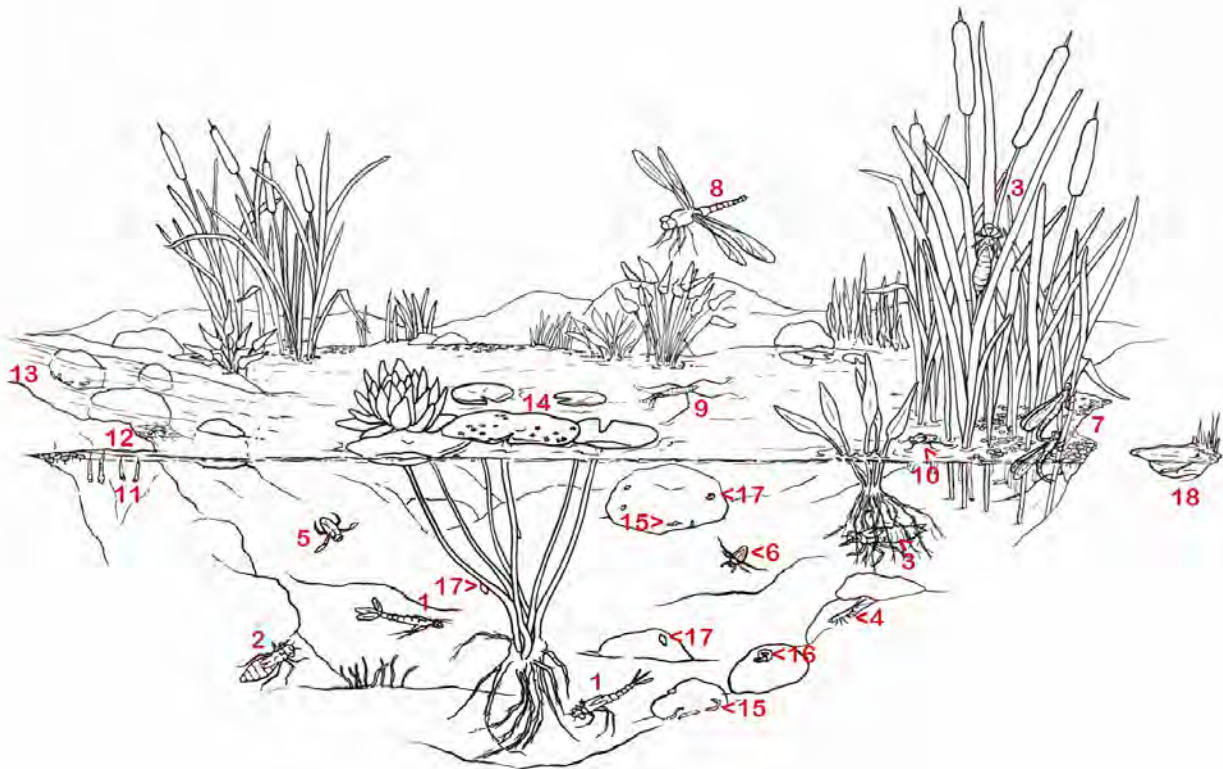
Pardosa species of **wolf spiders** (Family Lycosidae) are common along the edges of water bodies where they search for prey. These spiders are capable of running across the surface of water. In the shrubbery and taller vegetation surrounding water gardens, concentrically patterned webs of **longjawed orb weaver spiders** (Family Tetragnathidae) may be common.



A *Pardosa* species of wolf spider.

Notes and Observations

Life in a Colorado Water Feature



Key

1. Pond damsel nymph hunting for prey
2. Skimmer nymph lying in ambush
3. Nymph of a mosaic darnier hunting among roots; nymphal skin on emergent vegetation
4. Nymph of a small minnow mayfly
5. Water boatman
6. Backswimmer
7. Pair of pod damsels. Female (bottom) is ovipositing on submerged stems.
8. Meadowhawk/Skimmer adult
9. Water strider
10. Broadshouldered water strider along edge of pool
11. Larvae (wrigglers) of *Culex* mosquitoes in still pool
12. Larvae of a netspinner caddisfly attached to rock in flowing water
13. Black fly larvae attached to rock in flowing water
14. Waterlily aphids on a lily pad
15. Chironomid midge larvae in cases attached to submerged rocks
16. Planorbid snail
17. Physid (paper) snails grazing on algae
18. Rattailed maggot developing in oxygen poor pool.