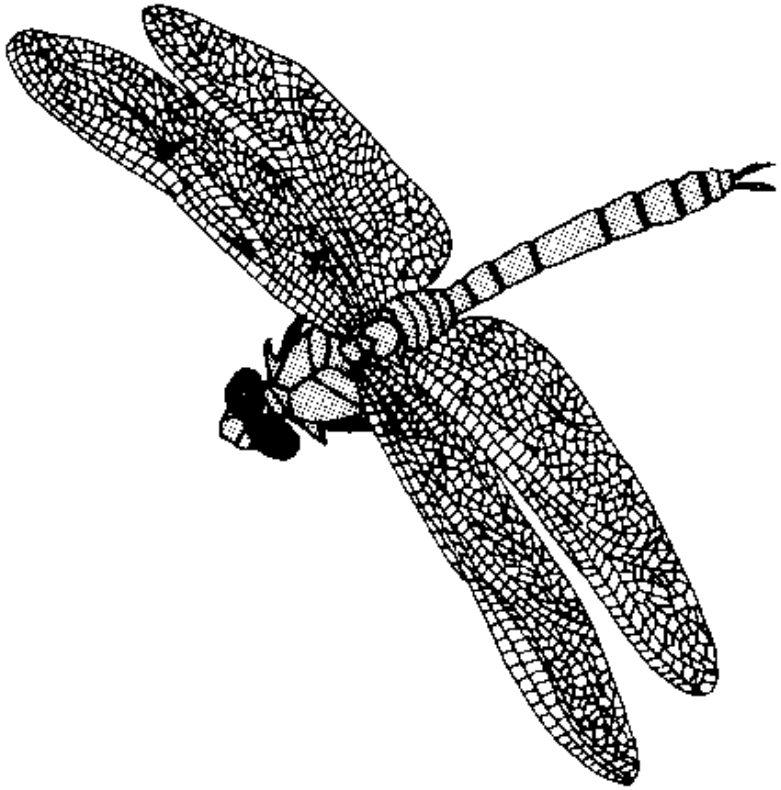

DRAGONFLIES

Introduction To Dragonflies and Damselflies of West Virginia

by
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in collaboration with
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illustrated by
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West Virginia University Extension Service

SERIES 801

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Contents

Dedication

This publication is dedicated to Dr. Paul Harwood, who wrote the manuscript on which the work is based, and who provided slides from which many of the illustrations were drawn. This publication could not have been begun, or ever finished, without his special knowledge and help. Appreciation is also expressed to Sally Harwood.

Biology

Introduction

Dragonflies fascinate us with their brilliant colors, swift, strong flight, and mysterious ways.

Names for dragonflies, which include devil's darning needle, blue pirate, bee butcher, black dragon, snake feeder, and mule killer suggest that dragonflies are more feared than admired. Such striking names conjure up vivid Images of ferocious dragons and fire-breathing monsters associated with the "winged tigers of the air," dragonflies.

Fierce predators with large appetites, dragonflies and their more slender and dainty but just as rapacious relatives, damselflies, do indeed live up to their reputations. They are efficient and effective hunters, devouring whatever they can capture and chow. They are also among nature's most beautiful creatures. Some of them display intricate designs of bold color and flashing iridescent hues.

Ponds, rivers, streams, and lakeshores are excellent places to observe dragon- and damsel-flies. Take a pair of binoculars with you and find a convenient and sunny place-dragonflies are more active in sunny conditions, and don't care much for rainy and cloudy weather-and soon you will probably see several species of dragonflies. Watching carefully, you will note that they have different shapes and colors. You will probably see the brilliant metallic blue and green of two of our most noticeable dragonflies, the green and blue darners. You may also see a differently shaped dragonfly with a blue-white tail. This is another common dragonfly called a white-tall. Should you see a small and dainty blue creature with its transparent wings held up in a vertical position when it perches, you are looking at a common damselfly, the bluet.

Dragonflies do a lot of flying, but frequently they will land on the ground or a stone within several feet of a quiet observer and you can see them quite close up, especially with binoculars. Damselflies will sometimes land on your hand, and then you can really observe them.

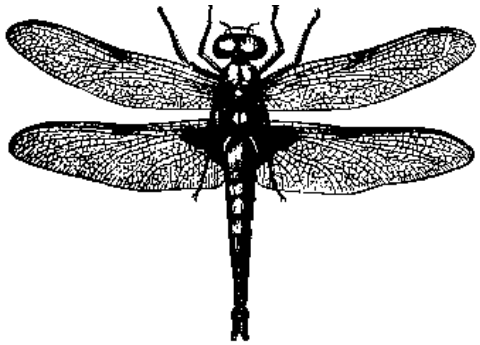
During rainstorms, dragon- and damselflies take shelter under plant leaves. Here also they may allow the observer to come close enough to photograph them.

If you have access to a boat, row it to a patch of aquatic plants, especially pondweeds, which have large floating leaves. Here you may find bluets and other attractive damselflies called violet dancers.

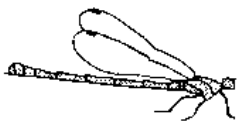
You may also find, as others before you, that the allure and fascination of the flitting and dancing damselflies, the gentle tap of waves against your boat, the undulations of the water vegetation, the warm sun, and the subtle charm of the world of water have involved you In a new and Intriguing pastime-the pursuit of dragonflies.

Classification

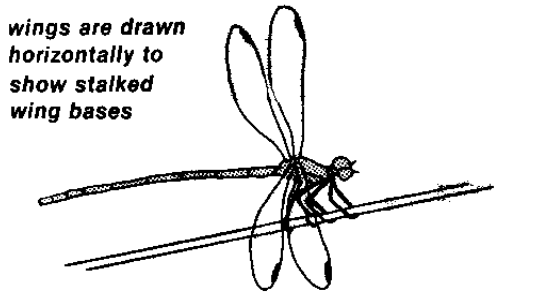
The formal Latin name for the insect order containing the dragonflies and damselflies is ***Odonata.*** Within this classification dragonflies are called ***Anisoptera*** and damselflies are called **Zygopters.** Differences between these two groups are easy to spot: dragonflies are robust in appearance and rest with wings outspread. The hind wings are broader at the base than the forewings. Damselflies are slender in appearance and rest with wings held up vertically. Their wings may or may not be stalked at bases.



(Fig. 1.) Dragonfly, wings outspread, hlnd wings broad at bases



(Fig. 2.) Damselfly, wings vertical



(Fig. 3.) Damselfly, wings stalked

In West Virginia,* approximately 200 species of **Odonata** may be found, while all Europe north of the Pyrenees has only 83 recorded species, despite more complete studies of that area.

History

Dragonflies are long-bodied insects with two pairs of wings, short bristle-like antennas, and large eyes. Our largest species, the hero darner, *Epiaeschna heros*, distributed in the eastern United States, has a wing spread of five inches. One of the largest and most common damselflies is the black-wing, *Calopteryx maculetum.* The largest living species of dragonfly is from Australia and has a wing spread of eight inches.

Dragonflies have been around a long time- earliest known fossils date back to the Permian geological age, nearly 220 million years ago. Only mayflies and cockroaches are older. Dragonflies living today haven't changed much over the geological epochs. However, fossils indicate that ancestors of our present day dragonflies were rather larger than our modern day forms, some having a formidable wingspan of two and a half feet and representing the largest insects known. Another prehistoric dragonfly, found in carboniferous coal shales in North America, had a wingspan of 24 inches.

Biologists consider dragon- and damselflies primitive insects. This is because they can't fold or flax their wings as do more advanced insects such as moths and beetles. Because their wings can't be conveniently "tucked away," dragon- and damselflies can't crawl under rocks or into crevices to hide. Instead, they must depend on their flying abilities to escape from predators.

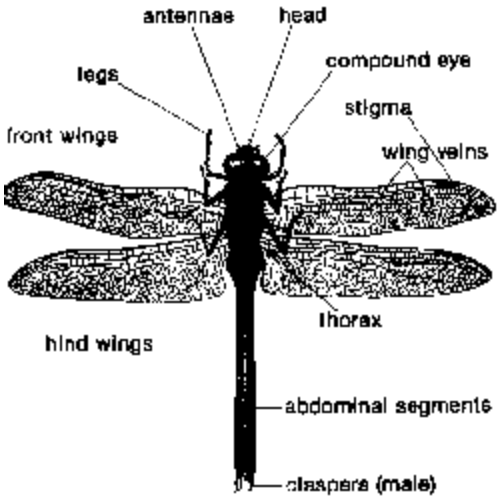
*The Entomology Department at West Virginia University and the Carnegie Museum at Pittsburgh have preserved Odonata specimens. The reader is urged to view them. Preserved specimens have a tendency to lose their bright colors. The true beauty of these insects is best seen in the field.

Since dragon- and damselflies have had to depend on their abilities as aerial specialists in order to escape danger, they have developed rather impressive aerial acrobatics. They can fly backward, hover, and stop on a dime. Dragonflies can wing along at speeds possibly in excess of 45 miles per hour. Unlike most other insects in which the front and hind wings beat in synchrony, or in which only the hind wings are actually used in flight, front and hind wings beat Independently.

Anatomy

Figure 4 illustrates the main parts of dragonfly anatomy. Identification of specific dragonfly groups, discussed in more detail later, is based on differences In the structures shown in Figure 4, including the shape of the eyes, wings, and abdominal structures, and in differences in the pattern of wing veins and cells.

The exoskeleton (external skeleton) of dragon- and damselflies is essentially the same as that of other insects. It is comprised of hard, rigid areas separated at joints or segments by chitinous membranous areas for flexibility. The exoskeleton serves to give the body color, texture, shape, and support for muscle attachment. It serves all of the functions of our skeleton plus skin.



(Fig. 4.) Dragonfly anatomy

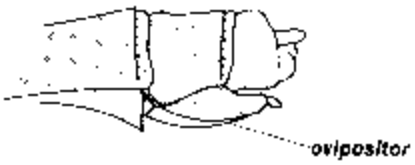
The body has three main divisions: head, thorax, and abdomen. The head is a hard capsule that has two large compound eyes, a pair of antennae, two pairs of jaws *(mandibles and maxillae)* that open sideways, and a lower lip *(labium)* The mouth and jaws are very efficient. Each of the compound eyes may contain several thousand unit-a called *ommatidia,* each of which is composed of a long rod-like structure possessing all of the elements for light reception. More than 28,000 ommatidia have been recorded for each eye of some dragonflies, more than for any other insects. Vision is keen, as befits these swift-flying creatures. Their excellent vision makes dragonflies a challenge to catch. Indeed, large nets designed to snare them usually catch more air than dragonflies.

The thorax bears the locomotion structures that consist of three pairs of legs (one pair for each thoracic segment) and two pairs of wings. The hind legs are twice as long as the front legs. Because of this imbalance, the legs aren't very efficient for walking. However, they form a convenient basket below the mouth enabling dragon- and damselflies to scoop up insects and feed on them while in flight.

All dragon- and damselflies are predacious. Having caught their prey, they will sometimes alight to chew it. Once the author watched a damselfly parch on a stem of grass to devour its prey, a tasty midge. The damselfly ripped off and discarded the dry wings and ate the succulent body. Dragon- and damselflies do not bother to kill their prey before consuming it. Prey is brought to the mouth, held by the mandibles, and sliced up by the maxillae. Adult dragonflies may consume some beetles but particularly hard-shelled ones may be carried for hours as the dragonflies seem unable to dent the strong cuticle of some beetles. Other food consists of mosquitoes, moths, bumblebees, and many other types of insect prey.

Wings are usually a transparent membrane strengthened by a network of dark veins. Wings of insects arose as outgrowths of the body wall, at first unhinged. Over the ages a joint developed, and the wings became moveable. Wings are powered by muscles attached to the body skeleton and moved by distortion of the thorax. Dragonflies evolved a few muscles attached directly to the Interior part of the wings. This in part accounts for their highly acrobatic flight abilities. The intricate network of veins in the dragon- and damselfly wings are important in identification since the shape and location of these veins varies from species to species, In some dragon- and damselflies the wings are entirely transparent, while in some they are yellow, amber, black or mottled with splotches of blue, tan, white or black.

The abdomen is a long slender tube made up of ten segments that may be counted easily with a hand lens. The first and last segments are the shortest. Female damselflies, and females of some species of dragonflies, have terminal segments of the abdomen modified by the presence of an *ovipositor,* a structure used in laying eggs. The tip of the male's abdomen has stout "claspers," which in the dragonflies are three in number-two above and one below. In the damselflies, the male has four claspers, one pair above and one pair below. Claspers are used to seize the female by the top of the first thoracic segment or on top of the head, a procedure preliminary to mating in dragon-damselflies,



(Fig. 5.) Apex of abdomen of damselfly, female

(Fig. 6.) Apex of abdomen of damselfly, male

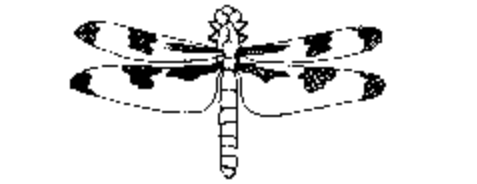
The sex organs of the male open near the end of the abdomen, at the ventral margin between the 9th and 10th abdominal segments. However, the organs associated with sperm transfer are on the lower surface of the second abdominal segment. Distance between the sperm ducts and copulatory apparatus is unusual; only spiders and squids have analogous adaptations. The male has to charge the sperm reservoir prior to copulation. The female is then seized by the male claspers and the two fly in a tandem position; the female bonds her abdomen forward, contacts the second abdominal segment of the male, and sperm transfer takes place. Distinctive reproductive structures insure intra-specific mating; hybrids are rare among dragonflies.

The female receives the sperm into a seminal receptacle where it may be stored for some

weeks, but a portion is generally utilized immediately after mating. Fertilization is accomplished just before eggs are deposited. This in-flight copulation is an example of how dragon- and damselflies are adapted to carry out vital life processes "on the wing."

As you observe the behaviors of these insects, you will notice that some female and male dragonflies have similar colorations, as is the case with the darners. However some females and males have different color patterns, especially on the wings, such as white-tails, illustrated in Figures 7 and 8.

(Fig. 7.) Male White-tail



(Fig. 8.) Female White-tail

Differences in color patterns also occur on the abdomen. The bright hues of male dragonflies may function in threat displays to thwart rivals-male white-tails whose abdomens have been painted black seem to be less successful at mating, because they can't defend their territories against competing males.

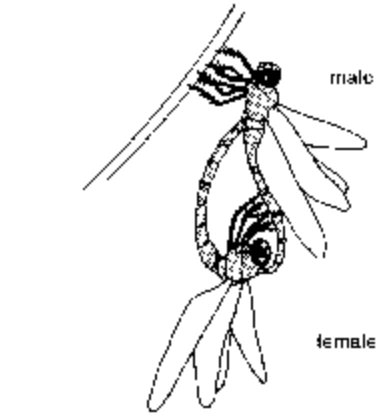
Life History

Reproduction: breeding season is from June to August. Males may visit the breeding area for several days in a row, and remain several hours. Females, by contrast, may visit the site only to deposit eggs, then leave to feed and rest in a nearby field, perhaps returning some days later to lay more eggs.

Mating begins when the male takes the female in tandem. The couple then band into the wheel position and copulate. Actual sperm transfer may take only seconds, after that the male may leave his mate, or he may hover while she deposits eggs, termed non-contact guarding, or he may remain in tandem with the female, termed contact guarding.

Guarding prevents another male from inseminating the female. The sperm from the last male to mate with the female will be used to fertilize the eggs-the last insemination is the one used. Indeed, in some species, the males remove most of a previous male's sperm mass. Guarding tactics vary according to need. In very competitive situations where there are many males present, guarding may be intensive, but may lessen or cease completely in the absence of intruding males.

(Fig. 9.) Tandem



(Fig. 10.) Copulation

Oviposition, or egg depositing, may begin immediately after copulation. Among many species of damselflies and a few dragonflies, the males lead the females to select an oviposition site-the pair flying in tandem. In these species, the male retains his hold on the female with his claspers while she places her eggs.

*In West Virginia oviposition may occur May to November.

Males of species that separate after copulation usually accompany the female to the oviposition site and hang around to protect her from interference by other males.

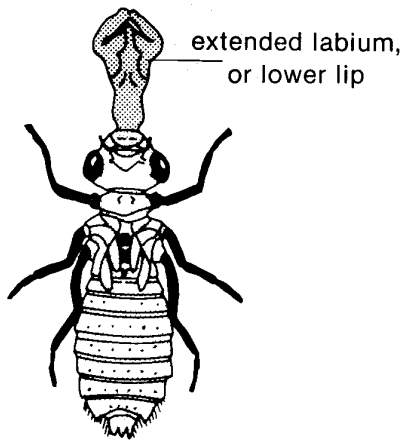
Each species has its own special way of going about the egg laying business. Species without an ovipositor place eggs directly in the water. For example, the female blue pirate, usually unattended by the male, flies above the water and dips the tip of her abdomen against the water's surface to wash off her eggs.

The green darner does things a bit differently. These females have a well-developed ovipositor, enabling them to puncture plant tissues and to place eggs in the plant. The green darner may or may not have her mate along as a pilot. Eggs are placed in cattails, pondweed, and other aquatic vegetation. The puncture marks are sometimes distinctively and evenly spaced. Some species, such as the black winged damselflies, lay eggs under the water and may remain submerged for up to an hour during the process. During submergence, the wings remain closed trapping a bubble of air, which may provide the oxygen necessary for respiration.

Eggs: Dragonfly eggs are microscopic and are of two types: elongate eggs which are two to six times as long as wide and which are, as with the green darner, placed in vegetation, and oval or globular eggs which are placed directly in the water. Usually, eggs hatch into nymphs (immature ***Odonata)*** in from two to five weeks after being deposited, but hatching time varies greatly even within the same species. In some groups such as the darners, ***(Aeshnidae),*** delayed egg development occurs. For instance, eggs may be deposited in late summer but won't hatch until the following spring, even if removed from the water and kept in a warm room.

Nymphal Stage: When the ***nymph*** *(or larva, or naiad,* as it is also called) emerges from the egg it is about 1/10th of an inch long. Should a nymph hatch from vegetation away from water, it jumps or crawls to the nearest source of water. The nymph is nourished for a few days by a yolk in its gut and when this is used it must begin to catch its own food. Nymphs are predacious and will feed on mayflies, stoneflies, and small fish.

The nymphal dragonfly differs radically from the adult in appearance and habits. The nymph is an aquatic animal, while the adult is of course aerial. The nymph has three body parts, though - just as the adult-head, thorax, and abdomen. The head is a fused box that is nearly globular in the dragonfly, but transversely elongated in the damselfly. The antennae are larger than in the adult and have numerous sense organs. The eyes are smaller, but are still important. The labrum (upper lip), mandibles (jaws), and maxillae (jaw-like structures) are similar to those of the adult, but the labium (lower lip), is modified into one of the most efficient predatory organs found in the animal kingdom.

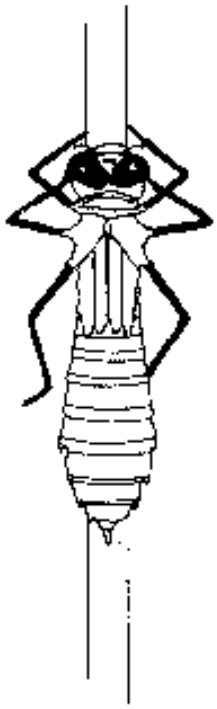


(Fig. 11.) Nymph of Red Sympetrum

It is a jointed structure that at rest is folded against the ventro-thorax between the front legs. It may be thrown forward by compressing the body muscles and forcing fluid into the labium. Among nymphs that dwell in quiet waters, particularly among submerged vegetation, the labium may be thrust forward more than six times the length of the head. The **distal** (situated away from the point of attachment) end of the labium is armed with two large lobes that are in turn armed with hooks and stiff bristles. These enable the labium to hold fast to captured prey. In the darners and club-tails, the labium is a flat plate at its distal end. In the biddies and the skimmers it is developed into the so called "facial mask." This spoon shaped organ seems to be more efficient than the flat labium, and it may be responsible for the greater success of the skimmers, in terms of numbers.

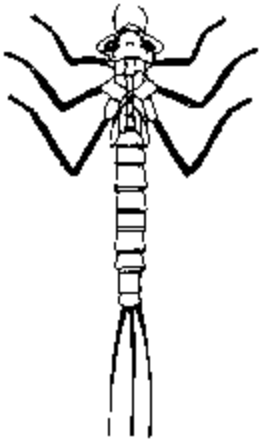
Depending on the temperature and food supply, nymphs can take anywhere from one to four years to reach the adult stage. The process is quicker in warm climates (the tropics, for instance) and slower in colder climates. Our green darners take about 11 months to become adults. Nymphs grow by shedding their exoskeletons. This molting process is termed **ecdysis.** Each time the exoskeleton is shed, the resulting nymph is bigger. Each stage is termed an ***instar,*** and it requires about 12 instars, separated by molts, before the nymph is

ready to change into the adult winged form. The wing buds begin to take form at about the 5th instar.



(Fig. 12.) Dragonlly nymph of Green Damer, 1 to 2 inches long

(Fig. 13.) Dragonfly nymph of Club-tail, 1 inch long



(Fig. 14.) Damselfly nymph of Fork-tail, ½ inch long

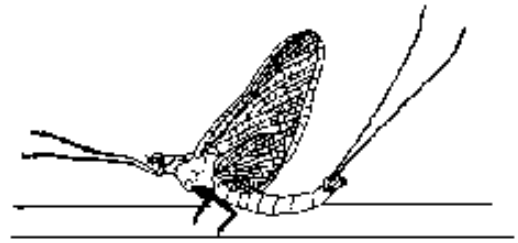
Nymphs can be classed into three groups, according to behavior: climbers, sprawlers, and burrowers. Nymphs of darners are climbers and climb in and out of submerged weed beds. Sprawlers usually have flattened bodies and lie flat on the mud with legs outstretched. Burrowers live shallowly buried in the silt and sand with the upturned tip of the abdomen reaching up to the water for respiration. The burrowers have nearly cylindrical bodies and legs with stout modifications for burrowing. Burrowers include the nymphs of dragonflies such as club-tails. Only the sprawlers and burrowers occur in rapidly flowing waters. Some burrowers are not so much given to burrowing as to slipping into crevices that the stones may offer. These show very little in the way of stout burrowing legs, and may be considered a transition form between the true burrowers and sprawlers.

We have discussed differences in the appearance of adult dragonflies and damselflies. The nymphs of these two groups are different also. The appendages on the damselfly abdomen are three leaf-like gills that serve in part for respiration. Dragonfly nymphs lack these external structures and breathe by means of gills housed within a specialized rectal chamber at the posterior end of the digestive tract. Dragonfly nymphs take in, and then expel, water from their gill chamber with such force that when they are in a shallow pan of water the noise made by the ejection of this water can be heard several feet away. Although the nymphs move primarily by walking, they can also travel by this sort of jet propulsion.

Nymphs are interesting to watch and do well in a home aquarium. To catch them, take a strainer

and sieve the sand and gravel under rocks in and along streams, or sieve through the mud in ponds. You will sooner or later find some nymphs, although the type and species of nymph will depend on the habitat. Those that live in ponds may crawl in submerged vegetation, depending on their protective coloration for escape. Your home aquarium should approximate the conditions in which you found the nymph.

If in addition to nymphs you find stonefly and mayfly nymphs and other similar aquatic life, take them with you, as they will provide a food source for your hungry nymph. If you plan to keep your nymph for a while, you need to provide a food source. Mosquito larvae are also tasty morsels. The author once kept a darner nymph in an aquarium for many months and it thrived on a diet of larvae and did quite nicely until the author added a crayfish to the aquarium and discovered what hungry crayfish eat: dragonfly nymphs.



(Fig. 15.) Mayfly, adult

(Fig. 16.) Stonefly, nymph

(Fig. 17.) Stonefly, adult

Dragon- and damselflies undergo what is termed incomplete metamorphosis from egg to nymph to adult, compared with such insects as butterflies and moths which proceed from egg, to larva, to pupa, to adult. Dragon- and damselflies don't pupate or produce a cocoon the way many moths do. As we have described, dragonflies and damselflies in the nymphal stage molt about twelve times over a summer or longer before they are ready to transform to the adult. At about the final instar certain changes begin in the nymph indicating transformation is about to occur. During this transformation the nymph is radically modified. The antennae become dwarfed, and the huge eyes reach final form. The jointed labium, or lower lip, is reduced to normal adult lip form. The last two thoracic regions are fused rigidly, and the legs are thrust forward and elongated. The wings emerge. The abdomen elongates and develops the functional external genitalia that are useful to the serious student of ***Odonata*** for identification purposes.

Transformation usually takes place near dawn, but may occur at noon. The nymphal skin splits down the back and the emerging adult literally crawls out, leaving the cast off skin, which is termed the ***exuviae.*** The newly emerged dragonfly is termed the ***teneral,*** which means soft, or delicate, and aptly describes the soft, newly emerged insect. The teneral adult expands its wings and allows them to harden and dry, and the change that takes about an hour from nymph to adult, is complete.

If you should find a nymph you think is about to transform, get a stick for a perch, put the nymph on it in a large jar and leave the jar in the morning sun for about an hour. Don't let the nymph overheat and die. With any luck you should be able to watch the whole process and have a teneral adult.

(Fig. 18.) Newly emerged dragonfly, the teneral

Changes in the adult dragonfly and damselfly still occur, but nothing so dramatic as the transformation from nymph to adult. We recognize three stages in the life of the adult: juvenile, or pre-reproductive, mature, or reproductive, and old age, or post-reproductive. Changes in color as well as physiology occur in these stages.

1. Juvenile stage. During this first adult stage, which is typically spent away from the breeding site, the insects feed, but don't exhibit sexual activity. Gonads mature during the first week. This pre-reproductive period may take from 3 to 30 days, the shorter time resulting from higher temperatures. Usually, small species become mature more quickly than the larger ones. Color changes may occur.

2. Maturity. During this second or reproductive phase, adults feed and make frequent visits to a breeding site. The insects may be found well away from water, but return to water to deposit eggs. Length of the mature phase is very variable but may be up to four or five months. Most dragonflies and damselflies don't live beyond this phase but some do survive into the third or post-reproductive period. During this phase, their color becomes dull, and visits to the breeding site cease.

With this description, we have gone full circle in the life history of dragonflies and damselflies.

Economic Significance

A question often asked is, are dragonflies of any economic significance? Potentially, yes. Dragonflies while in the nymphal stage prey heavily on the larvae of both black flies and mosquitoes. Adult odonates feed on adult black flies and mosquitoes-both of which are notorious pests. It is reported that the owner of a golf course in Maine became disillusioned with spraying insecticides for mosquito control. He ordered dragonfly nymphs at five dollars per hundred for three years - and reported no further complaints about injurious sprays, and few complaints about mosquitoes. With respect to the use of control measures, it should be remembered that in ponds treated with conventional insecticides, both pest populations and natural predators could be killed. In time, pest populations increase rapidly, but predators return and increase their numbers more slowly, thus worsening the original problem.

However, in order to control mosquitoes on a large-scale basis, it would probably be necessary to "raise" dragonflies specifically for the purpose-a dragonfly ranch, in other words. The serious entomologist could pursue this, but would need to determine suitable species for domestication. The western trotter *(Pantala hymena)* has been suggested, because it is of wide distribution and therefore well adapted ecologically and would probably adapt to various environmental conditions, and because it is a strong flying species quite capable of insect catching. Pens and suitable places for mating would need to be constructed.

On the negative side, dragonflies in the southern states are notorious for gobbling up queen bees on the nuptial flight, but this is not much of a problem in West Virginia where "package" bees aren't much raised. Dragonflies can do damage in fish hatcheries, where nymphs prey on small fish. However, this is off- set when dragonflies serve as prey for larger fish. Fish in turn are food for animals higher on the food chain, including birds such as herons and ospreys, both of which occur in West Virginia. And fish serve the needs of that most ardent group of fisherfolk-ourselves.

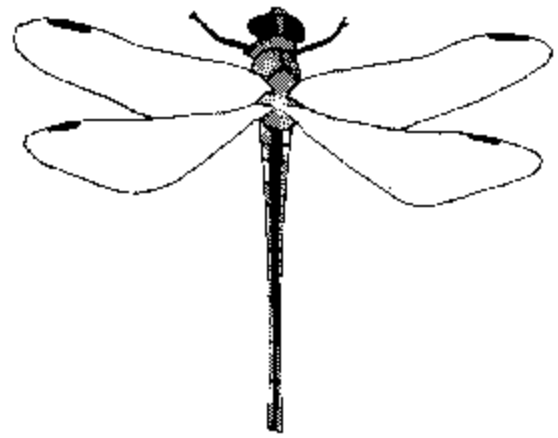
Species Found in West Virginia

The insect order *Odonata* is subdivided into suborder **Anisoptera** (dragonflies) and ***Zygoptera*** (damselflies). Each suborder, in turn, contains families made up of varying members of closely related species. A species is designated by two names, first the name of the genus and secondly the specific name. Latin names for ***Anisoptera*** are in accordance with listings in Needham and Westfall, *A Manual of the Dragonflies of North America,*

Dragonflies
Anisoptera

Petal-tails
Family *Petaluridae*

These are large, hairy dragonflies of primitive type and obscure gray color. They lack the refined form and coloration that goes with the specialized and greater numbers of more advanced dragonfly groups. The eyes are widely separated on top of the head. Dragonflies of this family were very common in the Jurassic period of geological history (the age of dinosaurs) but only 8 species exist in the world today, four of which live in Australia and New Zealand. Typically, the caudal or tail appendages of these species are shaped like rose petals, thus accounting for the name. Our two American species are not so decorated.



Eastern Grayback

Eastern Grayback
Tachopteryx thoreyi

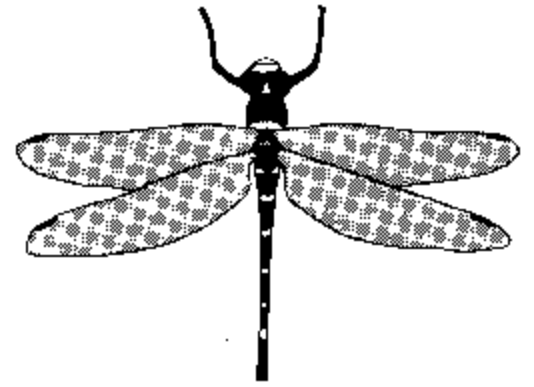
With a body length of about 3 inches and a 4-inch wing span, graybacks are large insects, sometimes called gray darners. This archaic looking white nosed dragonfly has a hairy, striped thorax and an abdomen that is bright gray (or black) alternating with light brown and yellow, although some specimens are dull gray brown. There are small spots on the abdominal segments. Wings are clear. Adults can be recognized by the long slender stigma that has 5-9 cross veins beneath it. Adults are found around swamps, streams, fields, and woods. They are swift flyers but they usually only fly short distances, and often perch on tree trunks. Usually easy to approach closely, they are not so easily captured.

The female may deposit eggs in small amounts of water or in wet vegetation. The nymphs, described as "rough-hewn," are angular, thick- set, and hairy, and live in spring bogs and seepage areas around springs.

Biddies
Cordulegasteridae

This is another primitive family with about 40 species, 8 of which occur in the United States. Four species have been found in West Virginia. Biddies are stout, hairy, and ruggedly built. Eyes are generally separated. Thorax is black with a pair of pale stripes on the front and sides. Abdomen is brown with yellow spots. Wings are clear; stigma is elongate, but not so much as petal-tails. Biddies occur along woodland streams. Males may fly long distances along the stream, flying only a foot or so above water.

Nymphs live in silt, sand, and gravel of small and sometimes large streams-in West Virginia, usually in clear woodland brooks and creeks. Nymphs are stocky, short-legged, and spindle shaped. The lower lip makes a mask over the mouth up nearly to the eyes. The two broad lobes of the labium have irregular teeth. Other nymphs with a mask instead of a flat blade such as in darners have lobes or teeth of equal length, or don't have teeth. The nymphs burrow by throwing sand out from under the body with the stout hind legs, reminiscent of a hen settling on her eggs- hence the name biddies.



Spotted Biddie

Spotted Biddie
Cordulegaster ***maculatus***

This species is about 3 inches long with a 3.2-inch wingspan. Thorax has pale stripes. The abdomen has paired yellow spots, usually one pair to each segment, but sometimes a smaller second pair occurs. Wings are clear with a tawny stigma. This is the most common West Virginia biddie and it occurs near small woodland streams.

Club-tails
Family *Gomphidae*

In some species of this family, abdominal segments 6 - 9 are widened conspicuously, suggesting a miniature club-the name Gornphus means club. Not all club-tails have this characteristic. This family is apparently derived from the more primitive petal-tails. The eyes are widely separated and don't meet over the top of the **frons** (front of head above antennae). Females have no ovipositor. Members of this family are small to medium sized but some are larger. Club-tails aren't as swift flyers as other dragonflies, especially darners, but make up for that deficiency by protective coloration. They are dark brown, usually marked with an alternating pattern of yellow and brown. Stigma is broad.

Club-tails are mostly denizens of streams, but some may be found about ponds. At least 9 species occur in West Virginia.

Nymphs are sprawlers or burrowers in the sand, mud, and gravel of fast flowing streams. Head is wedge-shaped. Legs are extended to the side and modified for burrowing. Nymphs of ***Hagenius brevistylus,*** the largest club-tail in West Virginia may be found where sticks, twigs, and bark are collected in a pool. These are large nymphs with cylindrical abdomens, and sprawling legs. The large head hides the usual hinged lower lip.

Spiny Legged Club-tail
Dromogomphus spinosus

This club-tail is 2.2 inches long, with a 3-inch wingspan. Ground color is dark brown with yellow markings on the face, an inverted y-shaped yellow mark on front of the wing-bearing thorax, and two lateral or side stripes. A stripe of arrowhead- shaped yellow spots extends down most of the abdomen. Wings are clear with yellow front margins and brown stigma. Abdominal segments 7 - 9 are moderately expanded into a club, especially in the male. This spiny-legged dragonfly has a row of short spines on the femur (long, thick segment near the leg base). On the underside of the femur is a row of 6-10 much longer spines-some 3 times as long as the numerous short spines. No other club-tail has the long spines on the femur although most species have the short spines.

Nymphs are typical of the family and have blunt heads.

A sub-group of club-tails, known as snake-tails, **(Ophiogomphus species)** also occurs in West Virginia. These are stream-haunting dragonflies of moderate size and green or green-gray color. The male has a four-lobed inferior appendage and the female may have thorn-like horns behind the eye. Because of their protective coloration and elusive habits-they don't often fly over streams, but perch on nearby vegetation-they are easily overlooked. They may be locally abundant but aren't much collected. Several species occur in West Virginia.

Darners
Family *Aeschnidae*

Darners, a dominant family today, and considerably advanced in color and habit over more primitive families, are large swift flying dragonflies often seen in late summer and fall. They are the devil's darning needles reported by many a folktale as responsible for sewing shut the mouth, ears, and eyes of disobedient children. Their colors usually are dark brown trimmed with blue, green, and yellow. A characteristic of darners is that their eyes meet on top of the head. In addition, female adults have a well-developed ovipositor. They are found around water of course but are also seen in city streets and other places far from water. Darners prey on mosquitoes, midges, moths, and crane flies.

When swarms of mayflies arise, darners may be seen devouring them.

Darner nymphs are active climbers and live in vegetation around still waters and stream edges. They have long slender bodies and long legs and are predatory and cannibalistic.

Janus Darner
Basiaeschna janata

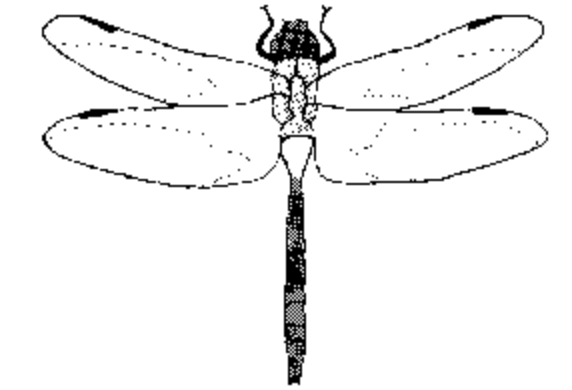
Smallest of the Darners, this species is 2.5-inches long with a wingspan of 3.0 to 3.8 inches. It is a brown darner trimmed with two yellow stripes on the thorax and small blue spots on the abdomen. Wings are clear with yellowish stigma, brown veins, and with a brown spot at the wing bases. Named after Janus, Roman God of beginnings and endings, this darner may fly and mate in late fall, hibernate, then fly again in spring. However, in colder locations such as northern Ohio and Canada, this dragonfly is on the wing in spring only.

Nymphs of the janus darner are common under stones of flowing streams. Torrential streams of higher elevations may lack this denizen. Nymphs are spindle-shaped. Color is variable but alternating light and dark rings on the legs are usually clear. Frequently there is a yellow spot on the back (dorsum) of the 8th abdominal segment. Nymphs are frequently found with those of another stream dweller, the brown darners *Boyeria spp.).*

Hero Darner
Epiaeschna heros

With a length of 3.76 inches and a wingspan of 5 inches, this is the largest dragonfly in eastern North America. Adults are olive to dark brown with green stripes on the thorax and pale rings on the abdominal segments. Wings are clear but tinged with amber-brown; stigma is brown. This relatively dull colored darner flies in the cover of forests, and consequently feeds in the shade, and may invade houses. More common in the glaciated regions of eastern North America than West Virginia, it ranges from Texas to Michigan and Ontario, Canada.

Nymphs, which live in shallow woodland ponds, are sometimes sluggish for darner nymphs; they have a central ridge on the last 5 abdominal segments.



Green Darner

Green Darner
Anax junius

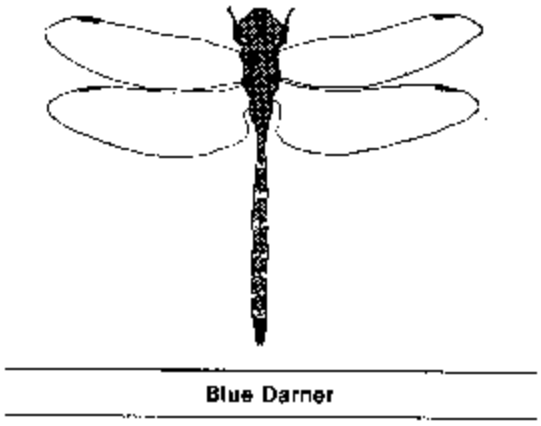
This common darner with a yellow face is 3 inches long with a wingspan of up to 4.25 inches. Thorax is dull green and unmarked with stripes or spots. Ground color of the abdomen is brown, with bright blue spots so large that in flight the abdomen appears blue. First and second abdominal segments are enlarged. Wings are clear but may be tinged with amber yellow. Stigma is tawny.

The green darner is a strong flyer and ranges far and wide. It may be found from the Arctic to the Antarctic, and has been recorded breeding at 50 degrees north latitude. The green darner occurs in Eastern Asia, Siberia, and parts of China. Its most striking conquest of space has been its migration to Hawaii, where it apparently evolved into the largest dragonfly in the United States, the Hawaiian giant.

Green darners may be seen in West Virginia as early as April. Egg lying begins promptly. Green darners oviposit in pairs, flying in the tandem position with the female placing eggs in aquatic vegetation just below the water line. Eggs deposited in spring soon hatch to nymphs that may transform to adults in October. Transformation usually occurs at daybreak and insects are airborne by 7 a.m. Adults of this species may be seen in the fall drifting southeastward around the Ohio River tributaries.

The nymph is brown with greenish decorations. It is very active, prefers large food, and will attack any minnow up to one and one-half its own length.

Another **Anax** species in West Virginia is the red-tailed darner ***(Anax longipes);*** this species has a green thorax and reddish abdomen.



Blue Darners
Aeschna species

This is the dominant genus of the family; 21 species are found in North America and from 6 to 12 occur in West Virginia. Size varies from 2 to 3 inches long with a 3 to 4 inch wingspan. Eyes are large, blue or green in life; thorax is brown with a pair of blue stripes on the front, and 2 pairs of stripes on the side. The abdomen may be patterned with blue, green, and yellow.

Nymphs, usually striped with green and brown, are difficult to identify as to exact species.

Clouded Blue Darner
Aeschna umbrosa

Within North America, this species has a wide range. It is less brilliantly blue than some species and in flight may appear brown. Spots on the female's abdomen may be green or yellow and not blue. Wings are clear with a tinge of violet and brown. This species generally lives in small streams with some current, and is partial to a shady environment. Other species prefer sun and open ponds. They can be found around streams where grass, sedges, and bulrushes grow. In West Virginia, clouded blue darners may feed in sizable flocks at sunset, often flying 10-15 feet above the ground.

Canadian Blue Darner
Aeschna canadensis

This is the next most common ***Aeschna*** in West Virginia. Just under 3 inches long with wingspan of 4 inches, it has large blue spots on the abdomen. Wings are clear; stigma is brown. Most numerous in the mountains, it can be found anywhere in the state, and ranges from Quebec to the Great Plains. Habitat is weedy ponds, lake margins, and sluggish boundaries. It may occur in sphagnum swamps, and seems to prefer higher elevation mixed conifers and hardwoods.

The Wasp-waisted Darner -*Aeschna constricta)* occurs in West Virginia but is hard to tell from the Canadian Darner. It lives in a relatively narrow band across North America from Nova Scotia to British Columbia and south to Maryland. It is commonly found in meadows with grassy ditches or small ponds-a habitat that isn't too frequent in West Virginia. It feeds at dusk on insects much as the clouded darner does. Te tuberculate blue darner *(Aeschna tuberculifera*) replaced this species is in the Eastern Panhandle. In the Dolly Sods area, the verticulate blue darner *(Aeschna verticalis)* that likes grassy spring runs, may be found. The mutate blue darner *(Aeschna mutata)* is rare but has been found in Mason County.

Skimmers
Family Libellulidae

These are the commonest and perhaps the best known dragonflies. Found hovering around almost every pond and pool, they are the most numerous dragonflies, and many are showy and brightly colored. The body is stout and abdomen is generally less elongated than in the preceding groups. Females usually lack an ovipositor.

Banded Skimmers
Subfamily Macrominae

These are large, strong flying clear winged dragonflies. They fly high and forage widely. Basic color is brown. A distinctive feature is a conspicuous yellow band slanting forward from the space between the wings to the base of the hind legs. They are found near large streams.

Nymphs are flattened with legs extended to the sides in sweeping curves. They are readily identified by a triangular upwardly projecting horn on the forehead. Two genera in this small family, *Macromia and Didymops,* occur in West Virginia.

Common or Illinois Banded Skimmer
Macromia illinoiensis

This species is 3 inches long; wingspan, 4 inches. It is dark brown to black with a slight metallic luster.

There are 4 yellowish spots on top of the frons. In flight a large yellow spot on the top of segment 7 is conspicuous. In hand, 3 pairs of small yellow spots may be seen on segments 2, 3, and 4. Wings are clear with a tinge of brown. These dragonflies fly over large rivers and lakes with wave action. They are a summer species, emerging in July, and flying through most of August.

Nymphs can be found in shallow water sprawling on the gravel.

Subfamily *Cordulinae*
(No common name)

These are strong flying dragonflies of medium to large size and tend to have metallic blue and green sheens to the body. Nymphs are sprawlers.

The Prince
Epicordulia princeps

Length of this dragonfly is 2.2 inches for the male and 2.4 inches for the female. Wingspan is 2.5 inches for the male and 3 inches for the female. The body of the prince is olive brown with a thin coating of gray hairs. The brown wings are beautifully marked with a basal spot, a spot on the nodus (mid joint of wing) and a spot beyond the yellow stigma. (In northern locations where these insects live these spots fade and at James Say the nodal spot vanishes). The prince is conspicuous because of its color and its habits. It flies around large streams and lakes and doesn't frequent ponds. The prince flies interminably, often far out over lakes, making it difficult to capture. One trick that may help is to throw a twig, which often the prince will swiftly pursue; then the net must be brought up quickly to capture the insect.

Skimmers
Subfamily Libellulinae

These moderate- to large-size dragonflies often have brilliant coloration. Attractive wing patterns may be in brown, red, or gold hues. There are sometimes differences in color patterns of males and females. Sometimes there is a development known as pruinosity, which means that with advancing age the abdomen turns whitish or bluish because of a bluish white waxy powder that obscures the original color pattern. These are dragonflies of ponds and shallow, still waters. They perch frequently and may be photographed or netted by placing a perch for them.

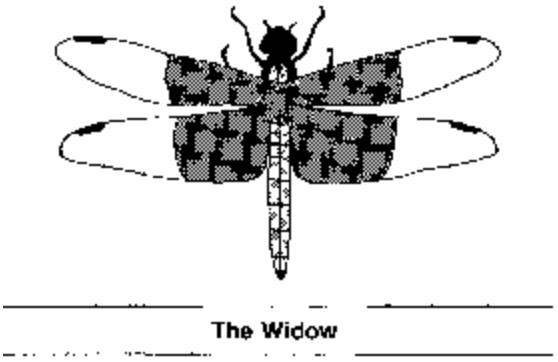
Nymphs sprawl or burrow in mud and are of stocky build.

10-Spot

10-Spot
Libellula pulchelia

About 2 inches long, with a wingspan of around 3.7 inches, the 10-spot is a beautiful dragonfly and a typical skimmer. Thorax is brown and white. Wings are spotted with brown; 10 chalky white spots develop with age, 2 on each forewing between the brown spots and 3 on each hind-wing; stigma blackish. The abdomen has 2 pale side stripes.

The 10-spot is very common and is found around still waters with emergent vegetation. Creeks and rivers meet its needs if there are still backwaters. As they oviposit unattended by the male, females strike the water vigorously. Cast skins left at transformation can be found in grass or weeds near quiet water.



The Widow

The Widow
Libellula luctuosa

This lovely skimmer with a 2-inch length and a 3.3-inch wingspan is distinctly marked. Thorax is

brown with pale stripes. Abdomen is blackish, striped with yellow. With age, the body may become pruinose on dorsal (top) side. In the male, wings are dark or blackish at the base, and a white area develops beyond the black in old specimens. In the female, the basal wing area is brown and usually no white area develops. In West Virginia the widow is very abundant and is found in ponds and still water. It frequently perches.

The Half Spot
Libellula semifasciata

This attractive slim species is about 1.75 inches long; wingspan is 3 inches. Thorax and abdomen have an overall waxy yellow-brown appearance. The wings are tinged basally with yellow-brown, and spotted at the nodus and tips with yellow-brown; stigma is rufous.

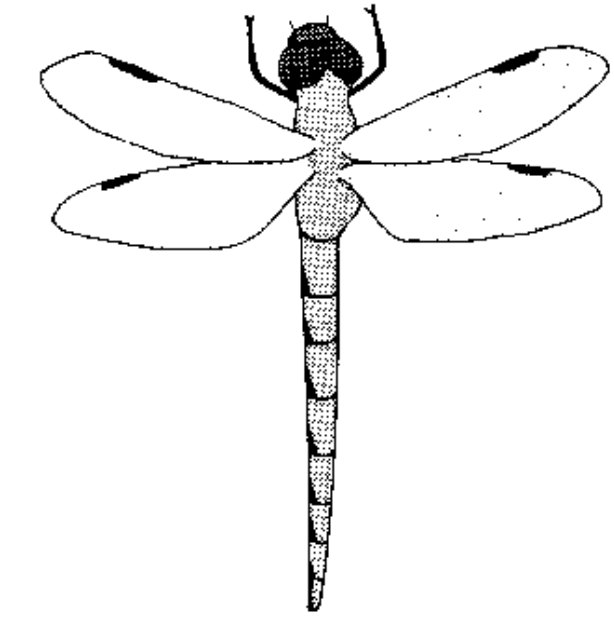
This is a spring species and probably transforms in late April and May. Often found in marshy swamps and swales, it may be numerous after a succession of wet years.

White-tail

White-tail
Plathemis lydia

White-tails are one of the most abundant Odonates in West Virginia-and indeed are reported from about 40 other states. They are also very active and hence conspicuous. About 2 inches long with a 3.75 inch wingspan, they are often found with 10-spots and darners and are almost certain to be found on small ponds and even mud puddles. Thorax and abdomen are brown. The abdomen tapers in the male, but is parallel sided in the female. The female has a row of pale spots on the abdomen; in the male the spots are less distinct and are obscured with age by pruinosity-which gives this species its name. Wings have a pattern of brown, again different in the sexes termed sexually dimorphic. (Figures 7 and 8). Behind the broad basal spot of the male, a large chalky white triangle develops with age.

White-tails don't perch so much on leaves and twigs as do other skimmers, but perch on logs, stones, paths and roads, where they are easily seen. As they oviposit, females dip their abdomens into the water at intervals of a second, depositing 25 to 50 eggs at a time; they can deposit thousands of eggs in a minute-which is about as long as they keep at the egg laying business. Sometimes several males will course around a pond together; when males meet there is much clashing of wings.

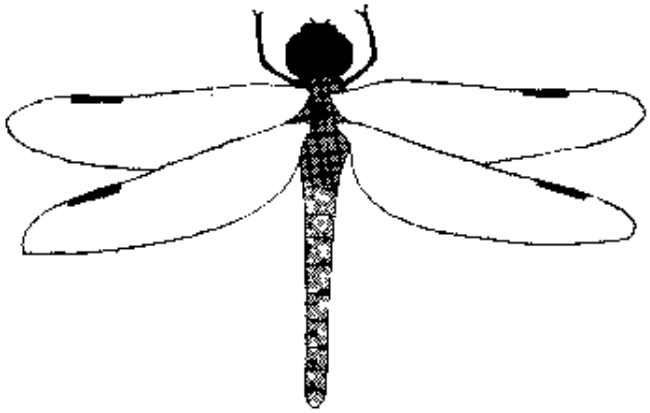


Red Skimmer

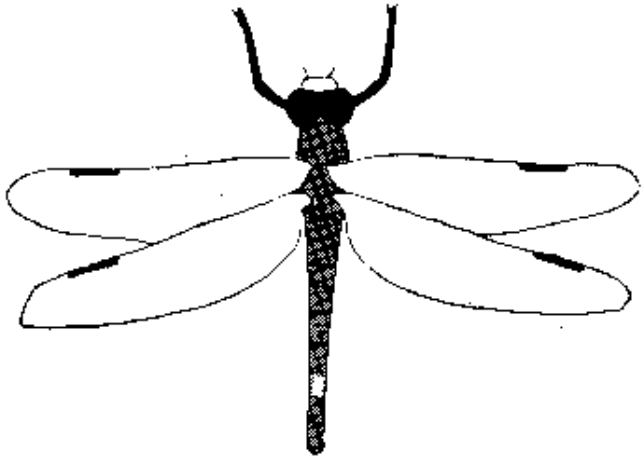
Fall Red Skimmer
Sympetrum vicinum

There are at least 4 species of ***Sympetrum*** *in* West Virginia. They are brilliant and striking in hue. The fall red skimmer is 1.4 inches long with a wingspan of 2 inches. Overall color is red or rufous and the red abdomen is marked with black at the sides. Wings are clear; stigma is rufous.

The tenerals, which are yellow, and gradually turn red, are abundant in early August in hay fields. The adult is easily recognized in September-October by its red face and body. Flight period may extend into November. This species breeds in ponds, swamps, and slow streams. Eggs are deposited in very shallow water or even in mud. Extended range of this species is from Maine to Florida and west to Texas.



Blue Pirate



Johnny White-face

Blue Pirate
Pachydiplax longipennis

The blue pirate is unique in the dragonfly world, both in color and habit. Size is variable, up to 1.6 inches long and wingspan of 2.6 inches. Face white, thorax pale green or olivaceous striped with brown. Base color of the abdomen is brown with yellowish spots. In the male, this abdominal pattern is obscured and turns pruinose blue with age, giving the blue pirate its name. Wings are clear or have a basal brown patch, and yellowish patch from the nodus to the stigma. In hand, the blue pirate is easily recognized by wing characteristics. There is only one vertical vein (cross vein) under the stigma, and that is at the distal end of the stigma. Other dragonflies have at least 2 cross veins under the stigma.

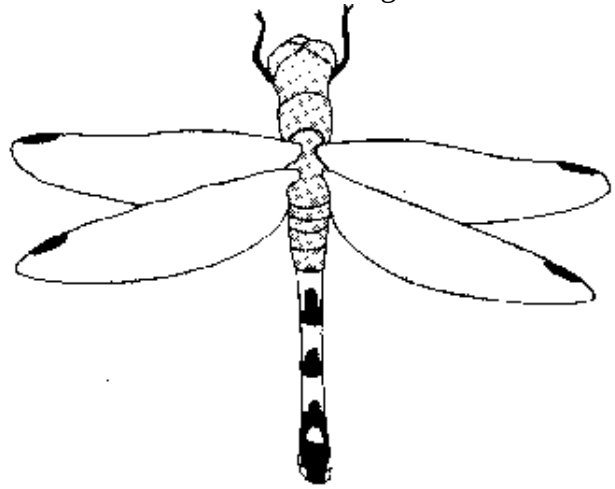
The male blue pirate can also be recognized by behavior. He will perch on a bare twig a couple of feet above water, wings thrown downwards and forward, abdomen raised sharply. This perch is soon deserted for a dash at another dragonfly-often a much larger species. Females are less in evidence, except when ovipositing or foraging.

The blue pirate is abundant all over its range, which includes the 48 contiguous states, southern Canada, northern Mexico, the Bermudas, and Bahamas.

Johnny White-face
Leucorrhinia intacta

This is a small but alert and agile species, 1.4 inches long, 2.1-inch wingspan. Basically a black dragonfly, it has a distinctive white face and a bright yellow spot (actually 2 spots which appear as one) on the dorsum of the 7th abdominal segment. The female is smaller and has a row of yellowish or reddish spots down the back of her abdomen. Wings are clear with a short broad stigma.

Johnny white-face prefers marshy ponds, and slow stream edges. The female is not much in evidence. After egg laying, she may shoot 20 feet into the air and vanish in the vegetation.



Green Jacket

Green Jacket
Erythemis sirnplicicollis

This medium sized species is about 2 inches long with a 3-inch wingspan. When it first transforms, it is a pale yellow green. The color soon deepens to green with black spots along the abdomen. As the male ages it turns blue gray with pruinescence. Wings are clear with a tawny stigma.

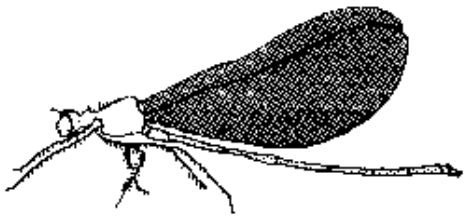
The green jacket is common in West Virginia around ponds. It is generally a low flyer, and perches on flat objects-lily pads are favored. This is a vigilant species, snapping up damselflies for a meal.

Damselflies
Zygoptera

Latin names for ***Zygoptera*** are in accordance with listings in Needham and Heywood's A *Handbook of the Dragonflies of North America.*

Black Winqs
Family Agrionidae (= Calopterygidae)
Broad-winged damselflies. Wings are not stalked.

These are relatively large damselflies with an elegant bronze green color. Body is slender; wings are often colored. The male has no stigma and in the female the stigma is irregular. These damselflies have a slow, wavering butterfly-like flight, fluttering from perch to perch. Nymphs are stiff-legged with rigid bodies, found clinging to roots and other materials in streams with current.



Black Wing

The Blackwing
Agrion maculatum (syn: Calopteryx)

This very common and conspicuous damselfly is up to two inches long and wingspan is 2.5 inches. The body is metallic green. Wings are suffused with lustrous, shining black in the adult male. Female has a general paler coloration. Black- wings are common in June, July, and August around riffles in small woodland streams and numbers of them may rest among tall grasses. They sometimes occur on ponds and larger rivers. The male courts the female with winged dances. The male perches in front of the female, spreads his wings, and closes them with a snap, or he may flutter with rapidly vibrating wings in front of the female. The female often spreads her wings and displays the white stigma. Females deposit eggs in vegetation or soft rotten sticks, where the water is flowing.

Ruby Spot
Hetaerina americana

These beautiful slender damselflies, 1.6 inches long, wingspan 2.25 inches, have a bronze and metallic green coloration. The male has a broad brilliant ruby spot at the base of the otherwise clear wings. The species described here congregates about larger rivers with current, but avoids swift current. Water willow, an aquatic plant with long slender leaves, seems to attract ruby spots. Similar to the habits of the black-wing, ruby spots flap their wings several times then dive through the air with wings closed. When the male flies the ruby spots are conspicuous, but aren't seen when the wings are closed. The ruby spot has the same courtship dances as the blackwings. The female usually oviposits alone. Transformation may occur in June; flight season is long - from July to October.

Family *Coenagrionidae*
Narrow-winged damselflies. Wings stalked.

Skulkers
Subfamily Lestinae

Skulkers inhabit areas of heavy vegetation around swamps and ponds or along vegetated sections of slower streams. In the midst of their shadowy habitat they can be difficult to see. Skulkers tend to have long slender bodies and short wings.

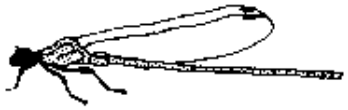
Say's Skulker
Lestes rectangularis

This slender damselfly is 2 inches long, and the wingspan is 1.6 inches. The background color is

dark brown, with yellow or green markings. Wings are clear with a large stigma. The abdomen is very elongate, but the wings are short - less than one half the length of the abdomen. Adults are on the wing from mid-June to September or later. Although widely distributed in West Virginia, this species is so retiring that it is easily overlooked. Say's skulker prefers wide areas in slowly flowing streams, but can be found in ponds. They seem to fly through vegetation rather than over it, and perch frequently on vegetation near shore.

Subfamily *Coenagrioninae*

These small damselflies are brightly colored-frequently blue, but sometimes green, yellow, orange, red, or purple, marked with black or dark brown. Males are often more brightly colored than females. Usually they live in ponds, small lakes, and stream backwaters (although the genus **Argia** prefers running water). The majority of West Virginia damselflies belong to this family.



Bluet

Common Bluet
Enallagma civile

These active and alert but small damselflies-length, 1.5 inches, wingspan, 1.8 inches-are frequently seen in West Virginia; indeed their range is enormous and extends from Guatemala to Nova Scotia to Oregon and Hawaii. Overall color is blue, with black markings. Appearing in June, the bluet is on the wing through September and October. They frequent ponds with emergent vegetation but occur on a variety of waters including rivers. Nymphs have been found in fast flowing streams.

Bluets are small and are weak flyers, and when the wind blows across a pond, the dainty bluets seem to vanish in the ripples. Males accompany females during oviposition. They retreat with her as she places eggs in a stem and backs down the stem with the placement of each egg. When the water reaches the base of the male's hind wings, he releases his mate and rises to a nearby perch where he will defend his territory. If pollutants lower the surface tension of the water, the female may be held in the surface tension and the male may come to her rescue by attaching his appendages to hers and pulling her out of the water.

Violet Dancer
Arg ia violacea

This lovely damselfly is about the same size as the bluet. Its range is not so extensive and is probably more common in the eastern states. The bright purple of the male is very distinctive. Females may be brown. Violet dancers frequent many types of aquatic situations but seem to prefer the reed vegetation of river and stream banks. About six species of ***Argia*** occur in West Virginia.

Common Fork-tail
I*schnura verticalis*

Within its range, Nova Scotia to Georgia, and west to the Great Plains, this small blue-green damselfly (length about 1.25 inches, wingspan, about 1.75 inches) is the most common damsel- fly in North America and is probably the most numerous Odonate in West Virginia. It is reported from every county in the state, can be found from May to October, and in most of West Virginia except the higher elevations has two broods a year. Habitat is quiet waters, such as weed bordered ponds, lakes, and small streams.

On the dorsum of the 10th abdominal segment there is a bi-lobed structure (lobed, rather than really forked, in this particular species) that accounts for the name. This species is also noted for its dimorphic females. Some females (termed homeochromic) have a color pattern that resembles the male, yellowish green over most of the body, but have bright blue on the dorsum of the 8th and 9th abdominal segments. Heterochromic females have a color pattern of orange and yellow, and black. Color gradations also occur.

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