A Beginner's Guide to DRAGONFLIES

Dragonflies form an important part of Wetland wildlife and they play a significant roll in its general ecology. They are among the most beautiful and spectacular insects flying today and they are also among the most ancient of living creatures.

1. Their Place in the Animal Kingdom

There are literally millions of species in the five Kingdoms within which biologists classify organisms, so that, in order to understand how particular species fit into an overall pattern, it is necessary to have some system of arranging them into a series of groups, so that each individual can slot into its own logical position. 'Classification' is a method of arranging living things into such groups, for convenience and for international understanding. Present-day classifications attempt to take into account as many features as possible and, in so doing, aim to reflect evolutionary relationships.

Kingdom. This is the highest category into which living things are classified. Until about 30 years ago, only two Kingdoms were recognised: Plantae (plants) and Animalia (animals). Today, most biologists use a five-kingdom classification system: Plantae, Animalia, Monera (bacteria), Protista (algae, protozoa, slime molds, and water molds), and Fungi. There is, however, increasing interest in a 6-kingdom system, which results from splitting the Kingdom Monera into 2 kingdoms--the Eubacteria ("true bacteria") and the Archaebacteria as members of a Superkingdom, the Prokaryota. The Animal Kingdom is divided in 22 PHYLA, of which the Chordata, which embraces birds and mammals, is one and the **Arthropoda**, to which the dragonflies belong, another.

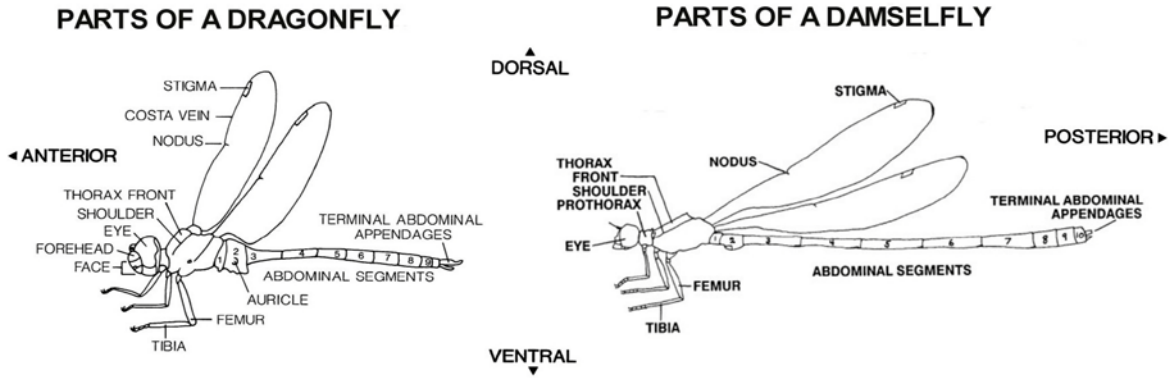
Arthropoda. Arthropods, despite the enormous diversity of their selected environments, all possess a basically similar structure, in that they are animals with an external skeleton - hence 'invertebrates': without a backbone. This means that, in order to accommodate their growth, arthropods must repeatedly shed one 'skin' and grow a new one. The life of a developing arthropod is thus punctuated by a series of moults, during which it is extremely vulnerable. In addition, since respiration cannot take place through their hard external surface, other methods of allowing the inhalation of oxygen have had to evolve. Arthropoda embraces five CLASSES, of which Arachnida (spiders, scorpions and ticks), Crustacea (shrimps, crabs, etc) and **Insecta** are three.

Insecta. Insects form the largest single group in the animal Kingdom and can be defined as creatures whose **bodies have three sections**: head, thorax and abdomen, the central one (thorax) bearing **three pairs of legs** and, in most cases, two pairs of wings. One of the Orders within Insecta is **Odonata** - and these are our dragonflies!

Odonata. This is an Order of insects whose members are loosely known as 'dragonflies' and which contains two main Suborders: Anisoptera (dragonflies) and Zygoptera (damselflies). In order to avoid confusion between the two meanings of the word 'dragonfly', it is easier to refer to the former as 'odonates', leaving 'dragonflies' for use when referring specifically to anisopterans. They are not difficult to separate from other orders of insects: adults have a pair of prominent compound eyes that take up most of the head, a contracted thorax bearing, as well as the usual three pairs of legs, two pairs of large, delicate, membranous wings, and a long, slender abdomen. They breathe through spiracles (holes) in the abdomen. During their earlier, larval, stage, the insects live in water and breathe through gills. During both stages, odonates exhibit voracious appetites, feeding exclusively on small animal matter. Contrary to general belief, they CANNOT sting - nor can they harm humans in any other way!

Generally speaking, dragonflies are larger and more robust than damselflies. Other differences between them are as follows:

Dragonflies	Damselflies
Generally strong fliers	A weak, fluttery flight
Eyes (apart from Gomphidae & one or two others) touch on top of the head	Eyes are well separated
Fore- & hindwings are of different shape	Fore- & hindwings are of similar shape
At rest, the wings are held away from the body at an angle of approximately 180°	At rest, the wings (apart from Lestidae and one or two others) are held close to the body



WDA is grateful to Sid Dunkle for permission to reproduce the above diagrams from his books *Dragonflies of the Florida Peninsula, Bermuda and the Bahamas* (1989) and *Damselflies of the Florida Peninsula, Bermuda and the Bahamas* (1990).

2. Their life history

Metamorphosis. This is another word for transformation and, in the insect world, it is applied to the changes that take place during the lifetime of a single individual. During the development of some insects there is virtually no change in form (except for size) from the moment of hatching out of the egg, to the fully mature adult. For instance, a newly hatched cricket larva is, in appearance, a tiny wingless replica of its parent.

At the other extreme, there are species that enjoy a complete metamorphosis: in the Order Lepidoptera (butterflies & moths), for example, the egg hatches into the caterpillar (larva) which pupates into the chrysalis (pupa), from which emerges the adult (imago).

Between these two forms of insect development is that of those subject to partial change and it is here that we find odonates. The pupal stage is omitted but the differences between larva and imago are considerable.

The Egg. Odonates have two different methods of laying eggs and the basic shape of the egg depends on the method used. All damselflies and, among dragonflies, the members of Aeshnidae (Hawkers), Neopetaliidae (Redspots) and Petaluridae (Petaltails) are endophytic which means that, having well formed ovipositors, they insert their eggs into plant material above or below the surface of the water; this is the more primitive method. Most other dragonflies are exophytic: these lack functional ovipositors and merely deposit their eggs directly onto the surface of the water or into mud at the water's edge. The eggs of endophytic species are long and cylindrical, while those of exophytic species are broad and elliptical.

At one end of the egg there is a minute hole through which the sperm enters just before oviposition and from which the larva will later hatch. In some species the eggs are surrounded by a jelly-like substance that enables the eggs to attach themselves to the leaves of plants or to stones and rocks under the water, so preventing them from sinking into the mud or being swept away by fast-flowing water. Although some species over-winter as eggs, most eggs start to develop soon after they have been laid and the larvae hatch out one to three weeks later.

The Larva. This is the growth stage of an insect's life. Like all Arthropods, the developing larva must repeatedly shed one outer casing in order to grow a new one. Periods between these moults are called 'instars' and the number of instars necessary to complete development varies between eight and fifteen. By the time the aquatic larva reaches its final instar, it will have developed all the organs and other attributes that will be needed to sustain life as a winged terrestrial insect.

Odonate larvae are aquatic and breathe through gills. In most damselflies, these take the form of three leaf-like appendages at the tip of the abdomen, whilst the gills of dragonflies are projections within the rectum. Both respiratory systems also serve the larvae as means of moving around in the water: damselflies' appendages are used as rear paddles and the pump that ventilates the dragonflies' rectal gills provides a spectacular jet propulsion.

The larvae of dragonflies have robust bodies that are somewhat bullet-shaped if they live amongst water plants, or flattened if they live in bottom deposits. Damselfly larvae have slender, cylindrical bodies ending in the three conspicuous leaf-like gills which sometimes bear striking patterns. Their chief predators are fish and frogs while their main source of food is fish-spawn, tadpoles and the larvae of smaller insects. The larval stage can vary in duration from about three months to four or more years.

Emergence. The larva having completed its growth and development will, when circumstances are right, leave its aquatic environment and start a new life, almost completely divorced from water. Although some species of odonates can emerge on a flat surface (Gomphidae for example and most damselflies), the majority need a vertical one; the larva climbs up the stem of a reed or other plant, until it is well out of the water, and affixes itself firmly by means of its claws. After a pause, the larval casing breaks at the back of the head and, slowly and laboriously, the adult insect emerges. 'Blood' is then pumped strenuously round the body, an action that expands the body and also the wing-buds,

transforming them into the beautiful lace-like wings which the insect will soon use to fly away from the water.

The Imago (adult). The necessary growth having been achieved during the larval stage, the imago can concentrate on ensuring the continued existence of its species: it is the stage of dispersal and reproduction.

(i) **Dispersal period**.
Immediately after emerging, young adults instinctively head away from water and fly off into the surrounding countryside. The dispersal period, which lasts from a few days to two or three weeks, is important in two ways. First, as will be seen later on, it has probably accounted for the survival of the Order Odonata. Secondly, it is the period during which the newly emerged insects attain full coloration and sexual maturity: they will not make their way to water until they are ready to mate..

(ii) **Reproductory period**.
This period lasts around two to three weeks in dragonflies and one to two weeks in damselflies, although the period is sometimes considerably extended.

The mating of odonates is virtually unique in the animal kingdom: although his sperm is produced (as is normal in all insects) near the tip of his abdomen, the male has an accessory organ on the underside of his second abdominal segment to which, prior to mating, he must transfer his sperm. When a male encounters a receptive female he will use the appendages at the extreme tip of his abdomen to clasp her securely behind her head (dragonflies) or neck region (damselflies) and both partners will curve their abdomens so that the female's genitalia engages with the male's accessory organ, the pair thus forming the characteristic 'wheel' position. Depending on species, mating may last from a few seconds to more than an hour. Before actually ejecting his own sperm, the male will sometimes remove any that may have been deposited by a previous suitor. Promptly after mating, the female will commence egg-laying and will then fly away from the water until she has another batch of eggs ready for fertilisation.

(iii) **Egg-laying**.
In some species this is carried out in tandem, the male continuing to hold his mate's head or neck while she deposits her eggs. In other species, the pair separates but the male will hover over the female, thus discouraging other males from mating with her. In a third group, the female oviposits totally unattended but, in these cases, she will do so in secluded places, often under a bank or among thick vegetation.

(iv) **Life expectancy.**
The average life expectancy of the adult odonate depends on the part of the world in which it lives. Generally speaking, in temperate zones the largest portion of an odonate's lifetime, which may amount to several years, is spent in the larval stage while the adult phase is one or two months. In species common to the tropics and subtropics, however, larval development may be reduced to a few months and the adult stage may last a full year.

In temperate zones, adult odonates that survive the vulnerable period between commencement of emergence and successful maiden flight, have an average life expectancy of 4-6 weeks (dragonflies) or 1-2 weeks (damselflies).

3. Survival

The question is often asked: "Why did dinosaurs disappear?" It is an interesting question and many different answers have been put forward. An equally interesting question is: "Why did odonates survive?" That can be answered by posing another question: "Why does anything survive?" Darwin had the answer to that, his well known theory being that nature selects the strong and discards the weak. Put in another way, creatures survive because they are able to make the best possible use of their environment. Dinosaurs did not manage to do this but odonates did and their success is largely due to a couple of very different factors:

(i) During their lifetime, odonates experience two totally different lifestyles. In almost all cases, the oval and larval stages are spent in water whilst the adult stage is an aerial one. Following emergence from their larval casing, the newly-winged insects instinctively fly away from the water, dispersing into the neighbouring countryside and sometimes travelling very considerable distances. This dispersal period has been a vital factor in their survival. Over the millennia, should one piece of water have dried up or should a river have changed its course, odonates were able to find suitable alternatives and would quickly colonise them. (Sadly this is no longer the case and it has become urgent that steps are taken to halt the decline in the number of suitable breeding places.)

(ii) The second factor leading to the survival of Odonata is the extreme efficiency of the basic body design which has proved capable of adapting to the many fundamental changes that have occurred on earth during the past 325 million years. Darwin also maintained that each species must find itself a niche that suits it best - or else die out. Odonates are aerial hunters *par excellence* and have occupied a niche in the environment which no other creature has ever managed to usurp.

4. How we can help them

Dragonflies are among the most ancient of living creatures. Fossil records, clearly recognisable as the forefathers of our present day odonates, go back to Carboniferous times which means that the insects were flying more than 300 million years ago, predating dinosaurs by over 100 million years and birds by some 150 million. It would be tragic if, after surviving such an unimaginable number of years, it should be our generation that witnesses a serious decline of these fascinating and beautiful insects.

Odonates develop in water and, in order to protect them, it is necessary to study the exact habitat requirements of each individual species and then to protect, conserve and, where possible, increase the number of suitable habitats. The habitat requirements of some species are narrow and these are obviously the ones that are most at risk. Other species species are catholic in their needs and will survive in almost any kind of water, a few even tolerating water that is brackish. The majority fall between these extremes, some requiring running water, some still and some bogs and marshes.

Sadly, suitable sites are disappearing faster that new ones are formed and, until that trend is reversed, there is continuing cause for concern. Rivers become polluted; ponds are allowed to become clogged up with debris and week; marshland is drained to satisfy the ever increasing demand for roads and houses; primeval forests are disappearing and, with them, the mountain streams which contain some of the world's most interesting and primitive species.

Important questions are: how can we ensure that no more odonate habitats disappear? and how can we encourage the spread of species that are not so seriously at risk? Here are some answers:

(i) We can dig small ponds in our gardens or back yards, larger ones in our school playing areas and even larger ones in various types of open space. It will not be long before dragonflies and damselflies start to colonise them, since many species readily discover new habitats

(ii) Farmers and other landowners can be urged to preserve their hedgerows and copses where adults shelter in dull weather, and to keep ponds and other water on their land clear of effluent. Lakes and ponds should not be allowed to become overgrown with reeds or other aquatic plants, nor should overhanging branches of trees be permitted totally to block out the sun.

(iii) We can join or, if necessary, set up a local group of conservation volunteers. The help such groups provide can be tremendously rewarding.

The continuing existence of these lovely insects lies in the hands of our generation. We must not let any more of them become extinct.

Jill Silsby

I hope newcomers to the wonderful world of dragonflies will find these introductory pages of interest and that they will provide answers to many of the queries I, and others, have been receiving. I suggest that, if your interest has been aroused, the next step is for you to join your own national Dragonfly Society. There is the British Dragonfly Society and the Dragonfly Society of the Americas, for example, and Germany, Holland, Japan, and many other countries have their own national societies too. We also invite you to join us in W.D.A. You would be very welcome!

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