

ODONATA (DRAGONFLIES AND DAMSELFLIES)

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Introduction

The order Odonata includes both the dragonflies and damselflies, separated into three suborders, namely Anisoptera (dragonfly-8 living families), Zygoptera (damselfly-17 living families) and Anisozygoptera (Williams & Feltmate, 1992). The third suborder, Anisozygoptera is represented by two species, one in Himalaya Mountains and another species in Japan – although only one family is now living, fossil evidence of 10 extinct families indicates considerable early diversity within this suborder. About 5,500 species have been described and they are distributed from the tropics, where the greatest numbers and diversity occur, to the tree-line in polar regions (Williams & Feltmate, 1992).

Being vigorous, dragonflies often seen flying back and forth or darting about inconsistently, especially along the shores and over the waters of marshes, pond, rivers and lakes, from early morning until late evenings. Some species are also seen patrolling rapidly over streams and lakes or through gardens at dusk. These conspicuous and brightly colored insects have long, slender abdomen and known as aerial predators, hunting by sight.

Morphology of Odonata

Adult Odonata are medium to large in size. The head is large with flexible neck, bearing well developed compound eyes either widely separated (all damselflies, some dragonflies), just touching, or extensively fused along the mid-line, three ocelli and a pair of short, bristle-like antennae. The mouthparts are modified for biting. The prothorax is small, the mesothorax and metathorax are large and fused into a single, strong pterothorax. Their two pairs of wings are long, narrow, and net-veined, and the legs are short, suited to perching and to holding prey, not to walking.

Adult Odonata possess two pairs of equal (damselflies) or subequal (dragonflies) wings. The wing veins of Odonata are fused at their bases and the wings cannot be folded over the body at rest. The abdomen is long, flexible, with 10 visible segments, and terminates in clasping organs in both sexes. In damselflies, the abdomen usually thin and cylindrical. Females of all damselflies and several dragonflies' families carry a prominent ovipositor under abdominal segments 9-10. Males always possess secondary genitalia on the underside of abdominal segments 2-3.

Dragonflies and damselflies differ in several important ways (Figure 1). The latter are smaller, more slender and delicate, slower and more uncertain in flight. In the dragonflies the front and hind wings are not similar meanwhile in the damselflies both wings are similar in size and shape. Dragonflies hold the wings horizontally outward when at rest, and damselflies hold them folded parallel with the abdomen or tilted upward

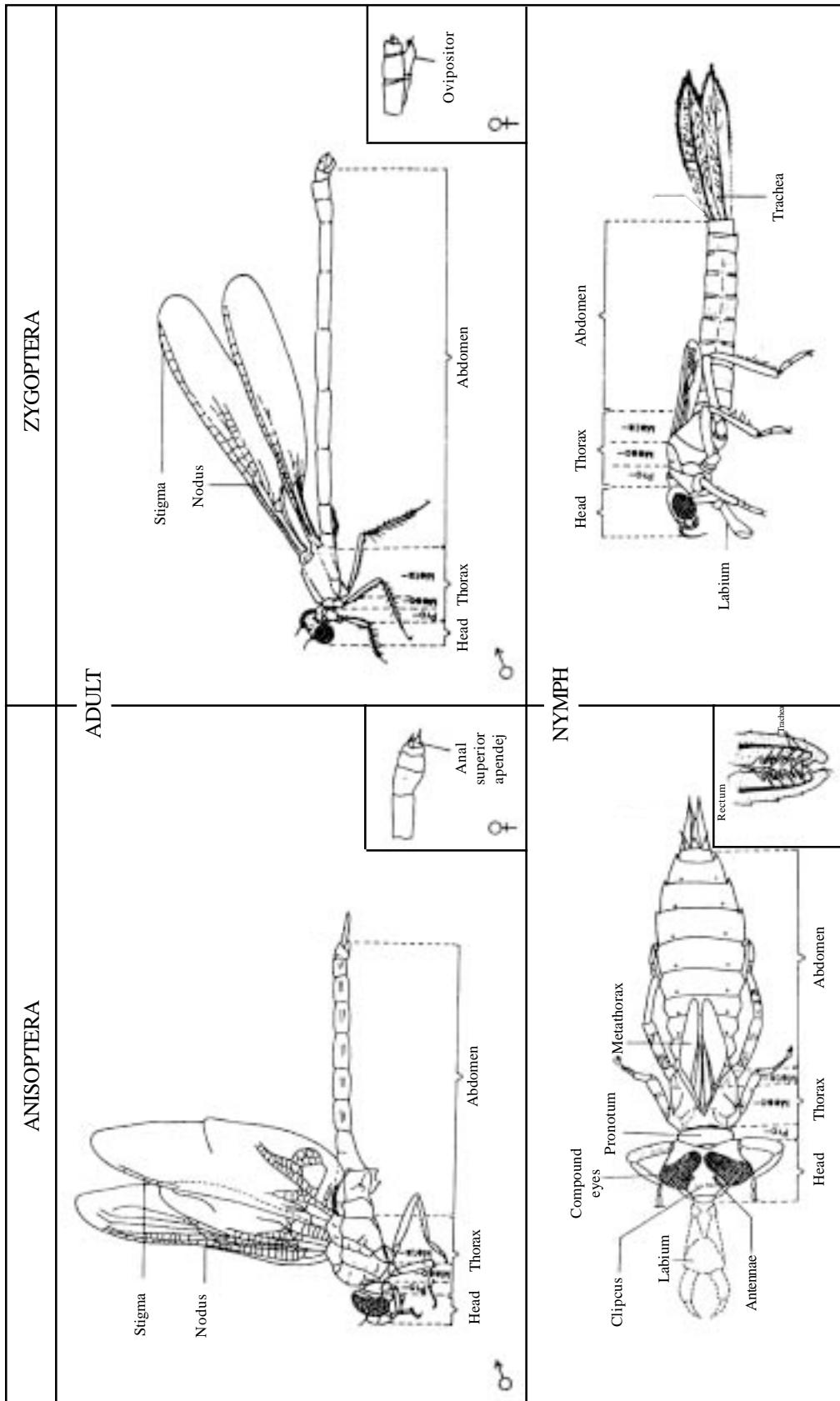


Figure 1 Dragonflies and Damselflies

Life cycle

Odonata are hemimetabolus as they only go through three stages in the life cycle that is egg, nymph and adult. Mating of the adults usually takes place on the wing in tandem position. The male then will return to his territory or perch while the female oviposits her eggs alone along the water surface. In some species, the pair lay eggs together, maintaining the tandem hold. In others the male hovers above the female while she lays her eggs. Eggs are laid into plant tissues on, above, or below the water surface. In species without a functional ovipositor, eggs are deposited onto the water surface or inserted into sand or mud. Egg development, mostly without diapause, may take several days or months to hatch, depending on species.

The nymph live underwater and moult up several times before the final instar crawls out onto overhanging rocks or vegetation. This final instar will then shed its last nymphal skin and emerge as an adult. Duration of nymph development to adult stage depends on the species and where they live. Some may take one or two years or utilise temporary water bodies to grow rapidly and develop into adults after a couple of months. Adults generally live for just a few weeks.

Feeding

Dragonflies and damselflies are predators as both adults and nymphs. The nymphs are non-discriminate hunters that will eat any animal as large as or smaller than themselves, including their own species. Nymphs feed on freshwater invertebrates catching them with specialised mouthparts that are able to spring forward and grasp the prey. Adults stalk on smaller flying insects by sight, catching them on the wing with their modified short legs.

Habitat

Dragonflies and damselflies can be found especially along the shores and over the waters of marshes, pond, rivers and lakes. Males tend to be territorial, staying close by water to guard their hunting and mating territory. They tend to congregate around the breeding sites where they may be seen either perched on waterside vegetation, hovering over small territories or hawking up and down in search of females. Females of many species spend much time away from the water, only appearing to mate and lay eggs, but some congregate with the males. Almost all odonate nymph are aquatic. They can be found in many aquatic habitats including either sluggish or fast running freshwater creeks, rivers, stream and lakes, and some species inhabit the more saline habitats of inland waters.

Collection

Collecting or catching adult Odonata, especially the Anisoptera, can be quite challenging, and often, a lot of fun. Usually a long-handed aerial net with a net opening of at least 18" is recommended. White nets make it easier to find the specimen in the net. A wide mesh is preferred because this reduces air resistance and allows a faster swing. For dragonflies in flight, sweep sideways and quickly toss the net bag over, trapping it inside. It is always best to swing from behind and below as these are the areas with poorest

vision. Both feeding individuals and those in sexual patrol flights may fly with regular beats, so you can foresee their flight path.

The dragonflies or damselflies caught are then placed in a glassine envelope or paper triangles with its' wings folded back. In general, only one specimen is kept in each envelope as they can damage each other. However, for pairs caught in tandem or in copula, they should be placed in the same envelope if possible, facing them away from each other. If they are too large to go together in a single envelope, then the fact they were mating is indicated on both envelopes. The collection number (cross-referenced to field notes) and information such as locality, date and the collector's name should be written on the envelope using pencil or ink that is insoluble in acetone (if the acetone treatment is used).

Preservation techniques

The specimens are left in their envelopes for a while so that they can void their intestinal contents. They are then killed by immersing briefly in acetone. The abdomen is straightened and the legs are arranged in place for each specimen, so they do not obscure the genitalia on the second abdominal segments of males. They are then put in their labeled envelopes and submerged in acetone (in a tightly closed plastic container) for 16 – 24 hours. It helps to cut off a bit of each lower corner of the envelope so the acetone drains when the envelope is lifted out.

Acetone extracts fat and water from specimens, and they dry much better and with better color preservation than when merely air-dried. Avoid prolonged breathing of acetone fumes, a little might not be harmful, as dragonfly collectors do not seem much weirder than other people do. Specimens with extensive pruinosity may become discolored in acetone. In particular, spreading damselflies (Lestidae) and a few pruinose skimmers such as the Common Whitetail, *Libellula lydia*, change color rather drastically, and you may prefer not to place them in acetone.

The specimen are then removed from the acetone and placed in the open for a few days so the acetone will evaporate. Preferably have a well-ventilated spot away from people as it evaporates. Try to separate the envelopes for quickest evaporation. All dried dragonfly specimens are stiff and brittle, although those that have been acetoned are stronger and more resistant to breakage.

Specimen are then taken out of the glassine envelopes and stored permanently in clear envelopes made of cellophane, mylar or polypropylene (Figure 2). The identification and collection data are typed on 3" x 5" cards, which are inserted in the envelopes behind the specimen. The envelopes are then stored like a card file in cabinets.

If unwilling or unable to use acetone (sometimes the case when traveling), an alternative is to let the dragonfly die in the envelope; by excreting feces from its abdomen, in which the abdomen dries better. To preserve dry, the specimen is then pinned on a spreading board (similar as in preserving butterflies) and spread the wing. Make sure the abdomen is straightened out rather than curved. Then put it in a dry place or oven at 35 °C to dry thoroughly. The dried specimen is stiff and brittle that it has to be handled carefully when transferring into collection box (Figure 3).

Another alternative is storage in 70 – 80 % ethanol, either in envelopes or without them. If envelopes are not used , specimens may later be removed from the alcohol and dried in envelopes in the correct position. Most collectors consider both air-drying and alcohol storage less desirable than acetone treatment.

All specimens should have the ecological information associated with locality where it was found, collection date and the collector's name. The taxonomic label includes genus or species name (depends on identification level), identification date and determiner's name.



Figure 2 Specimen preserved in acetone and dried



Figure 3 Specimen preserved dry

Identification

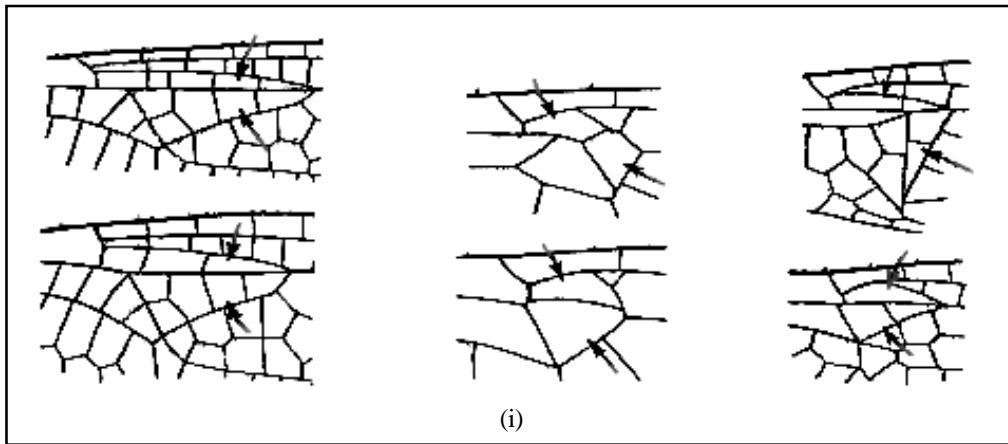
Adults: Identification is based on wing venation. As for dragonflies, the hindwing is broader than the forewing. In both wings a crossvein divides the discoidal cell into a triangle and supertriangle shapes (Figure 4A). In damselflies the two pairs of wings are almost exactly equal in shape, size and venation with numerous crossveins (Figure 4Bi,ii,iii). In most families pterostigma is present near the wing tip (Figure 4B).

Nymph: The most obvious characteristic shared by all odonate nymph is a conspicuous grasping labium (lower lip: mask), used for capturing prey. At rest the mask is held folded underneath head and thorax, extending back as far or further than the front legs and in some families far enough forward to cover the face below the compound eyes. In prey capture the labium is shot rapidly forward and prey is grasped with paired, hand-like palps. Even from above and with the mask retracted, identification of nymph to order and suborder is very easy, based on several other features.

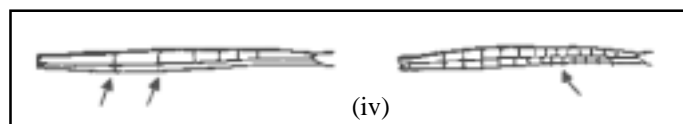
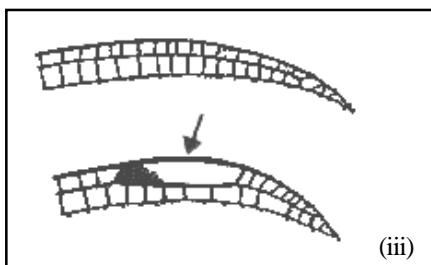
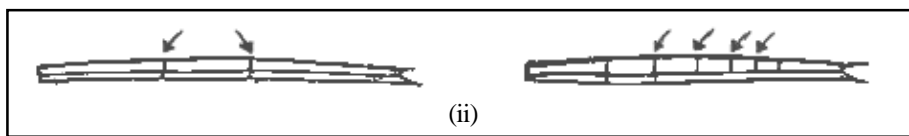
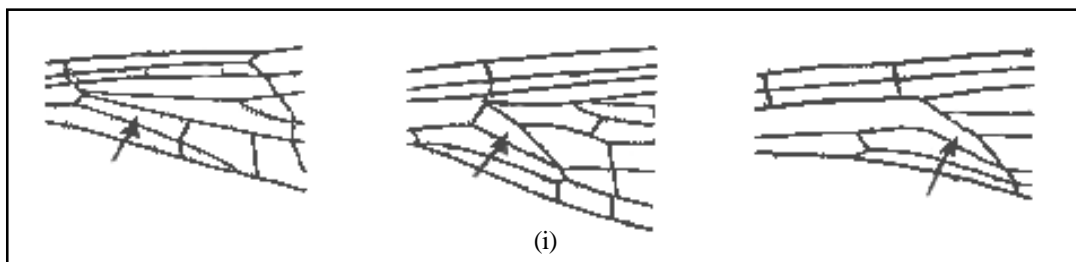
Important facts

In most part of the world, Odonata are of little economic importance. Their main attraction for humans is aesthetic as they are beautifully coloured. Adult dragonflies are also taken as a minor food item in some countries. In certain cases, the presence of odonates may be useful as an indicator of ecosystem quality. Changes in water flow, turbidity, or in aquatic or waterside vegetation are quite influential to the local faunal composition. The greatest numbers of species are found at sites that offer a wide variety of microhabitats. Dragonfly nymphs are beneficial to human because they can be used as baits and to assist in the control of aquatic insect pests (such as mosquitoes in domestic water tanks). In some countries, such as Japan, Odonata is a popular subject of art and culture, and similar to butterflies and birds, it has been a topic of popular scientific interest. In the European folk tradition, odonates have a less favorable status where they are called as “horse-stingers” or “devil”'s darning needles”. Odonates neither sting nor bite and the entire species are harmless. They are beneficial to humans because as voracious aquatic predators they assist in the control of insect pests.

Important wing characters used in identification of Odonata (adapted from Watson, & O'Farrell, 1991)



A. Wing venation of dragonflies (arrows showing the discoidal cell)



B. Wing venation of damselflies (arrows showing the discoidal cell in (i); antennodal crossveins in (ii); presence and absence of pterostigma in (iii) and crossings of basal antennodal crossveins in (iv))

Figure 4 Wing venation characters of dragonflies and damselflies

References:

- Carle, F. L., and D. C. Wighton, 1990. Insects from the Santana formation, Lower Cretaceous, of Brazil. 3. Odonata. *Bulletin American Museum of Natural History* 195: 51-68.
- Watson, J. A. L., and A. F. O'Farrell, 1991. Odonata (Dragonflies and Damselflies). Ch. 17 in CSIRO (ed.) *The Insects of Australia. A textbook for students and research workers.* 560 + 600 pp. 2 volumes. Carlton. Melbourne University Press. pp. 294-310.
- Williams, D.D. & Feltmate, B. 1992. *Aquatic insects.* CAB International. Wallingford, UK.