

Odonata (Copulatory Mechanism)

Aditya Kumar Sharma^{1*} and Rajnish Kumar²

¹Research Scholar (Ph.D.), ²Professor & Head, Department of Ag. Entomology,
Baba Raghav Das Post Graduate College, Deoria - 274 001, Uttar Pradesh, India

Corresponding Author

Aditya Kumar Sharma

Email: adisharmajmd098@gmail.com



OPEN ACCESS

Keywords

Dragonfly, Damselflies, Odonata, 2nd abdominal segment of male and Wheel Position

How to cite this article:

Sharma, A. K. and Kumar, R. 2026. Odonata (Copulatory Mechanism). *Vigyan Varta* 7 (04): 193-197.

ABSTRACT

This study explores the Copulatory mechanism of Dragonfly and Damselflies. It belongs to the Odonata order. It exhibits a unique and highly specialized mode of reproduction that distinguishes them from most other insects. Their reproductive behaviour involves complex mating strategies, specialized anatomical structures and a strong dependence on aquatic habitats. In both Dragonflies (suborder- Anisoptera) and Damselflies (suborder-Zygoptera), reproduction begins with an unusual mating process. The male first transfers sperm from the primary genital opening near the abdomen (9th segment) tip to a secondary copulatory organ (2nd abdominal segment) located near the thorax. During mating, the male grasps the female behind the head or thorax using specialized appendages forming a structure known as the “tandem position.” The female then bends her abdomen forward to connect with the male secondary genitalia forming the characteristic “wheel position.” The eggs hatch into aquatic larvae (nymphs/naiads) which are active predators and undergo several moults before transforming into adults. This aquatic phase is crucial for growth and may last from a few months to several years depending on environmental conditions. Overall, the reproduction of dragonflies and damselflies is closely linked to freshwater ecosystems and involves distinctive behavioural and physiological adaptations that enhance survival and reproductive efficiency.

INTRODUCTION

Members of Odonata are medium to large-sized insects with elongated bodies, two pairs of transparent wings, and large compound eyes that provide excellent vision. They are diurnal (active during the day) and are skilled predators, feeding on a variety of small flying insects. Both dragonflies and damselflies spend a significant part of their life cycle in water, making them closely associated with aquatic ecosystems. Dragonflies belong to the suborder Anisoptera. They are strong, fast fliers and are often seen hovering, gliding, or darting over water bodies while Damselflies belong to the suborder Zygoptera. They are more delicate and less robust compared to dragonflies.

Their reproduction and associated behaviour are unique among the animal world. The behaviour is complex but universal within dragonflies and damselflies, although with difference species there could be some minor variations. Reproduction is the central goal of Odonata, ensuring their genes pass to the next generation. Their reproductive system and behaviour are unlike those of any other insects. Some dragonflies and damselflies species show very strong territory behaviour while some species do not. A territory is defined as a fixed area that an animal defends against intrusion from other of its own species. In dragonflies and damselflies, the territory will usually be a good egg-laying site (Keith. 2003).

Male reproductive anatomy

Male dragonflies and damselflies possess two separate sets of reproductive organs:

1. Primary genitalia for producing sperm, located near the tip of the abdomen on 9th segment.

2. Secondary genitalia for insemination located near the base of the abdomen – on 2nd & 3rd segment in Dragonflies and 2nd segment in damselflies.

Because these organs are not connected, the male must first transfer sperm from the primary to the secondary genitalia. Dragonflies perform this transfer before approaching a female, whereas damselflies do it once the pair has formed a tandem (A mating posture where the male clasps the female with his anal appendages).

The male dragonflies and damselflies will return to their breeding ground and stay there when they mature and ready for mating. Most male Dragonflies perch on their favourite spot and overlook their territory. The male and female dragonflies will usually fly, non-stop within a fixed path over their territory. When there are the intruders of the same species male (sometime other species as well), the territory holder will drive away the intruder, by showing better body colour, better flying skill, larger in size or some other advantages. Sometime the very close and violent contact is occurred. The males will stay in their territory and wait for the female. In most dragonflies and some damselflies, females only visit their breeding site to mate and lay eggs. They will leave the breeding sit after laying eggs, until next batch of eggs are ready. When the female enter the male territory (or when a male meet a female in the non-territory species), they will start the next mating sequence, the courtship and recognition.

Stages of Copulation

1. Courtship and Recognition
2. Grasping and Clasping
3. Tandem

4. Intramale Sperm translocation
5. Copulation invitation
6. Copulation - Wheel Position
7. Tandem after Copulation
8. Guarding Oviposition

1. Courtship and Recognition: Courtship and recognition includes the male showing his oviposition site to the female. By courtship, the male and female can make sure they are the same species and are suitable mates. The female may reject the mating if she thinks the oviposition site is not good enough. There are different courtship pattern for different species. However, courtship is not so common in dragonflies and damselflies. For most species, no courtship can be seen. For some species, after the female enters the male territory, she will immediately be grasped and clasped by the male and the couple will mate. Some species males just snatch unwary females while they are warming in the sun. Some species males even grab the immature ones, shimmer-fresh after emergence. For the non-territory species, there will also be the courtship and recognition stages. They may swarm and several males may pursuit the same female. This is common in damselflies. If the female do not accept the male, various signal will be made, depends on species. The most common is the downward curving of her abdomen. If the female indicates acceptance, the male will grasp her thorax with his legs. Some species, such as the Banded demoiselle (*Calopteryx splendens*), perform elaborate courtship displays along rivers and streams. No matter there is the courtship or without courtship, after the male grasp the female, they start the next mating sequence, Grasping and Clasping.

2. Grasping and Clasping: The male grasps the female head or thorax and curves his abdomen to clasp her prothorax or head with his anal appendages to form the tandem pair. This action usually takes less than a second. At this stage, the couple is said to be 'in tandem position'.

3. Tandem: Tandem position is the male seizure of the female head (dragonflies) or prothorax (damselflies). The male and female will be in tandem for a while, from seconds to minutes. They may fly in tandem or find a suitable place to settle [Figure:1 (A) and 1(B)].



Fig: 1 (A). Tandem position of Dragonfly



Fig.1 (B) Tandem Position of Damselflies

4. Intramale Sperm translocation: All insect males have their genital opening for sperm at the ninth abdominal segment. Dragonflies/damselflies males have (beside the first genitalia) their secondary genitalia, which is the accessory organ on the second

abdominal. Sperm is moved from the first genitalia into the secondary genitalia just before copulation. For dragonflies the males do this before he finds a female. For damselflies the males do this immediately afterwards.

5. Copulation invitation: After forming a tandem and the sperm in the male secondary genitalia is ready, male damselfly invites copulation by wing flapping and flexing the abdomen. The female responds with bending up her abdomen to the genitalia of the male and form the wheel position. Dragonflies usually start copulation in flight, the male swing up the female.

6. Copulation - Wheel Position: The female then curls her abdomen forwards to contact with the secondary genitalia in order to receive sperm. The male and female form the heart shape wheel and it is known as Wheel Position [Figure.2 (A) and 2 (B)]. Notice that in damselfly male is holding by female's neck (prothorax) while in dragonfly is holding the back her head. Most damselflies settle and perched for copulation. Most dragonflies start copulation in flight, some may continue in flight and some may settle. Settle copulation usually last longer, from minutes to hours. Air copulation may last only a few seconds. For some species, it is found that before transferring his sperm, the male will remove the existing sperm from the female genitalia which is from earlier mate, and then replace it with his own.

Due to this unusual arrangement, mating does not occur 'tip to tip' as in most insects. Instead, the female must bend her abdomen so that her segment 8 or 9 connects with the male's secondary genitalia. This forms the characteristic 'wheel' posture, unique to Odonata.

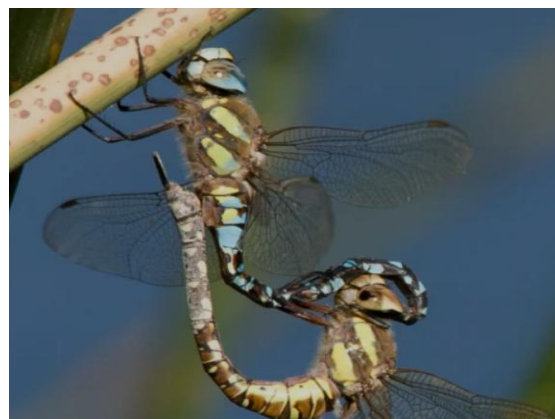


Figure. 2 (A), Wheel Position (Dragonfly)



Figure. 2 (B), Wheel Position (Damsselfies)

7. Tandem after Copulation: After the copulation the couple may separate or remain in tandem, depends on species. A long period of Tandem Position may be occurred after copulation. The couple may be at rest or in flight and there is no genital contact. The reason could be the male waiting for the female for the readiness of oviposition. By holding the female, he can make sure she does not mate with other male before laying eggs.

8. Guarding Oviposition: Oviposition takes place usually immediately after copulation. The male often accompanies the female when she oviposits. Eggs are laid in two general ways, some species females, they have their sharp ovipositor which can cut into plants and deposit eggs into there. Some species do not have their sharp ovipositor and simply drop their eggs into waters (Figure:3).

Some species in tandem with the female dipping her abdomen tip quickly into the water surface wash away the eggs by water. Some species the male hovers around and guard the female when she is laying eggs, which is common in many territorial skimmers.



Figure: 3. Oviposition under the water by Female dragonfly

The adult male and female may live 7-10 weeks. A female may lay several batches of eggs. Each batch she may lay a few hundreds to a few thousand eggs, depends on species. Those eggs may hatch after 5-40 days; depend on species, temperature and other conditions. The nymph survives into the water a long period of time and this ability is called Naiads (Aquatic predatory larval stage). Generally, there are about 10-15 instars stages, may take one to ten years living in waters, depends on species. Then they emergence and become adults. A new life cycle is started.

REFERENCES

Keith, D.P. (2003). Field Guide to Dragonflies of Hong Kong, Cosmos Books, p27.