Section C
Articles based on Posters

Collection and Preservation of Insects

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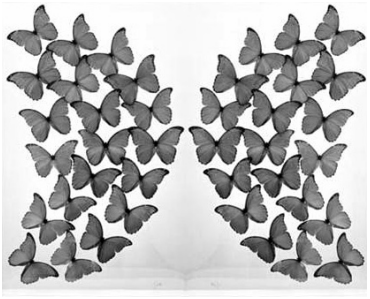
Why Insects Should Be Preserved?



Every insect is having a particular life cycle in a particular period. Insects may not be available for study according to our convenience. So we preserve the insects.

Collection Of Insects

For Collecting Insects Devices Are Used According To The Habitat Of Insects-

For collecting insects in water reservoirs following things are used

- Waterproof nylon net
- Perforated small metal utensils

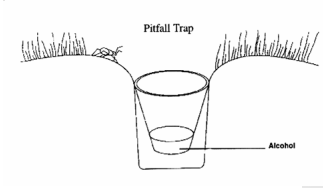
For Collecting Insects Living In Soil:

Pitfall trap – As shown in diagram a trap is set in the ground. Crawling insects fall in the trap.

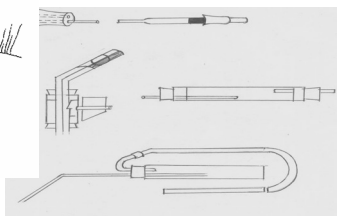
Berlese funnel – In this funnel soil sample is kept on the screen and the bulb is put on. Due to heat the insects get repelled and get collected in bottle on the lower side.

Aspirator – This is used for very small insects which are sucked in the tube.

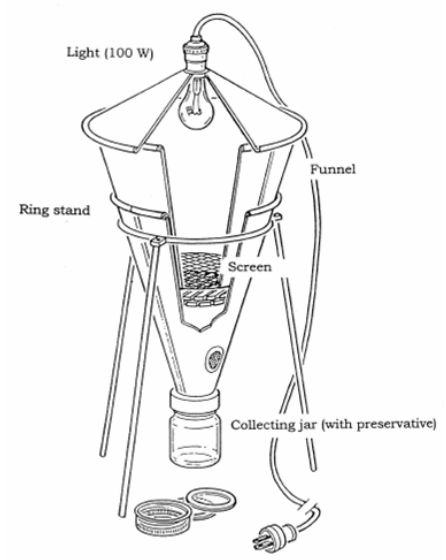
Hand picking is a common method used for collection of relatively less active insects.



Pitfall trap



Aspirators



Berlese funnel

For Collecting Insects From Air

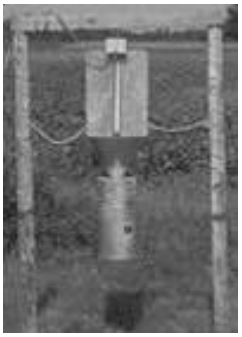
Light traps – Different types of light traps are used with different light sources.

They attract the insects which get collected in a container below from which they can not escape out.

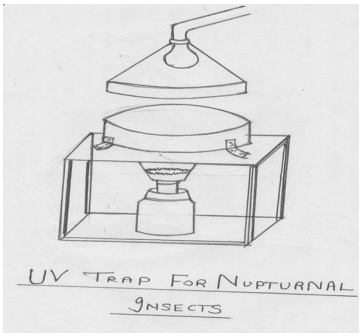
Sticky traps – These are hanged or suspended in the air. Insects sitting on them or striking them stick to them and get trapped.

Water traps – The flying insects fall in these traps.

Manitoba trap – This is used for capturing Horse flies which get attracted to the lower round portion of the ball due to its' resemblance with the belly of horse.

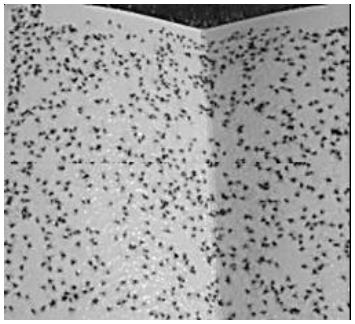


Black light (Tube light) trap

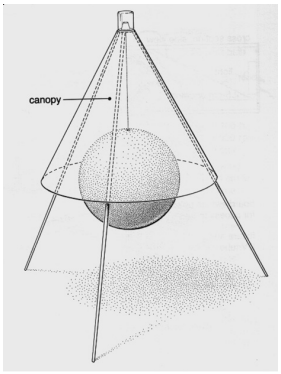


U V light trap

Water pan trap



Sticky trap



Manitoba trap

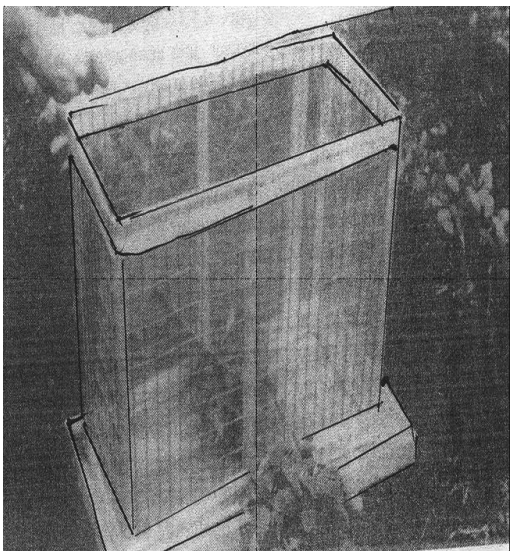
For catching insects from trees and plants

For this purpose following traps are used.

Sweep net and hand net are commonly used. The others include enclosure type traps such as Frame trap, Polythene enclosure (In this a branch is enclosed and insecticide is sprayed to kill the insects.) etc. Bigger suction devices are also used.

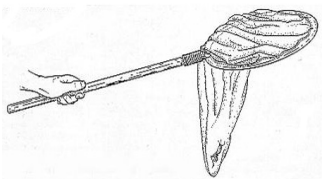
The simplest device is Stick and white cloth; the cloth is put below the tree and the stick is used for shaking/ beating the tree to make insects fall on the cloth.

Frame trap



Polythene enclosure

sweep net

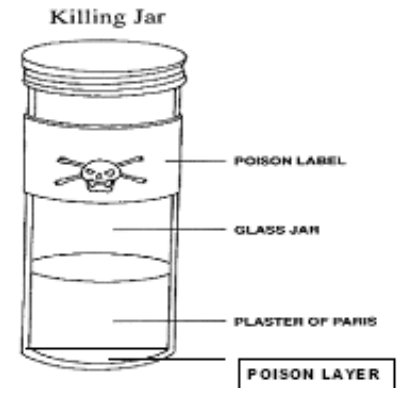


hand net

Preservation Of Insects

For Killing Insects Killing Jar Is Used With Following Details

- Size:150 X 100mm thick
- Poison layer:5mm thick
- Plaster of Paris layer:10mm thick

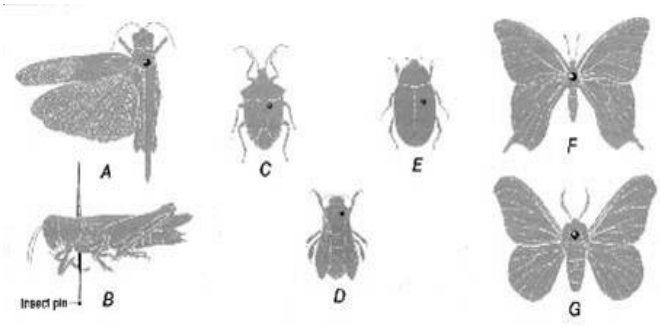


Poisons Used For Killing Insects

INSECTS	Poisons
Anoplura(Sucking Lice)	Alcohol
Collembola(Spring Trails)	Alcohol
Coleoptera(Beetles)	Alcohol or Ethyl Acetate vapors
Corrodentia(Book Lice)	Alcohol
Dermaptera(Ear wigs)	Cyanides,Alcohol,Ethyl Acetate Vapors
Diptera(Flies)	Cyanides
Ephemeroptera(May Flies)	Alcohol
Hemiptera	Cyanides,ethyl Acetate Vapors,Alcohol
Aphids	Alcohol
Hymenoptera (Bees,Wasps,Ants)	Cyanides
Isoptera (Termites)	Alcohol
Lepidoptera (Moths & Butterflies)	Cyanides
Mallophaga (Biting Star)	Alcohol
Meloptera (Scorpian Flies)	Cyanides
Neuroptera (Lace wigs)	Cyanides
Odonata (Dragon Flies)	Cyanides
Orthoptera(Grasshoppers,Crickets,Roaches)	Cyanides
Pleoptera(Stone Flies)	Alcohol
Siphonaptera(Fleas)	Alcohol

Drying the insects:

- Spread boards are kept in oven at 50-60^{0}C for one to two days till insects dry completely.
- They may be kept in box with 60w bulb suspended inside.



Pinning positions for different insects

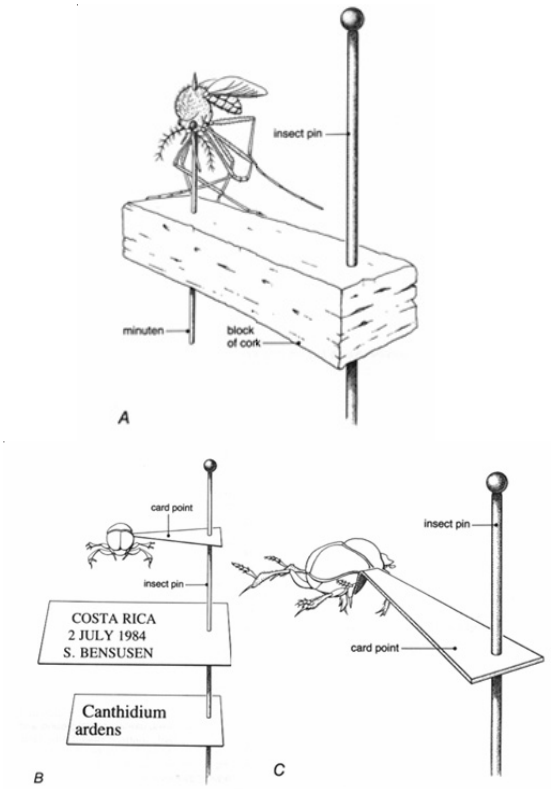


Figure showing Mounting of small insects and labeling styles

Precautions for preserved insects

- Napthol Balls are kept in four corners of Preservation Box.
- In case of infection Fumigants like CCl4 ,CS2 , Ethylene Dichloride, p-Dichlorobenzene are used.
- To prevent infection dusting inside boxes is done with 5% DDT or suitable toxicants.
- For protection from Mould;boxes are treated with a saturated solution of Naphthalene in Benzene.

References

- Entomology & Pest management by Larry Pedigo. Pearson Education Publication.
- Insect :year book of Agriculture – US Department of Agriculture(Agriculture research service).
- Kitakanche jag (Marathi) by Dr.Purushottum Joshi. Mahajan publishing house. 500,Narayan Peth , Pune.
- Online information by United States Department of Agriculture (Agriculture research service)

Life Cycles of Insects

Department of Zoology, B.N. Bandodkar College of Science, Thane.

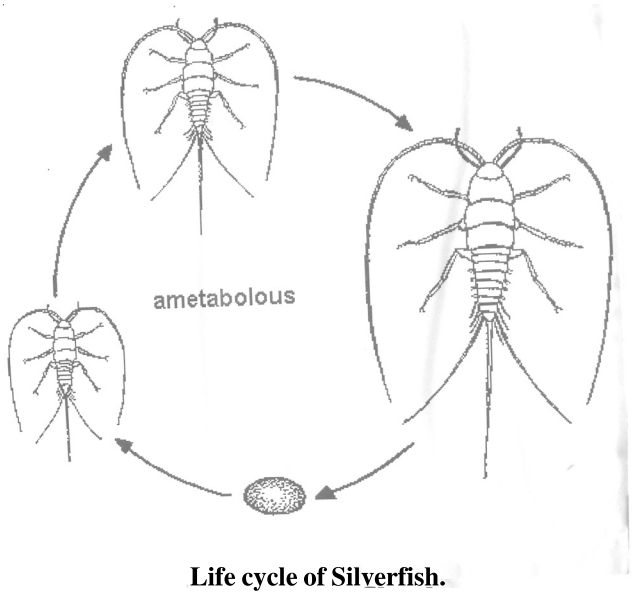
In life cycle of insects they show major changes in Morphology. For example Larva to Butterfly. This is known as Metamorphosis, Depending upon the extent of the changes there are different types of metamorphosis,.

No Metamorphosis (Ametabola) :

From the egg hatches a young one which resembles the adult. It grows and attains sexual maturity.

Eg: Silverfish- This insect being wingless

The external morphology does not change from young to adult.

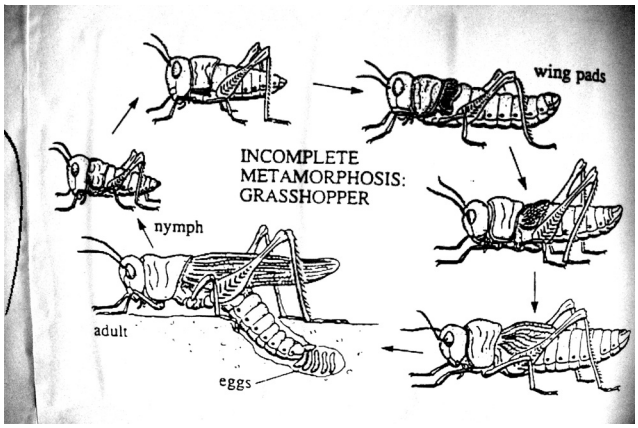


Life cycle of Silverfish.

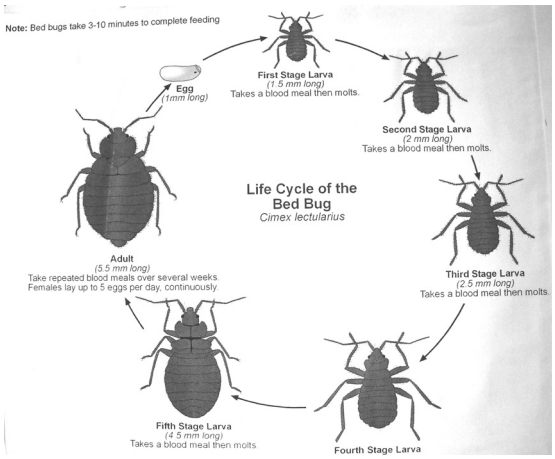
Incomplete metamorphosis (Hemimetabola) :

From the egg hatches young one which almost resembles the adult, except that certain structures like wings etc. are absent. The young ones grow, molt and again grow to attain sexual maturity and there is also development of wings. Thus as the insect growes from young to adult it shows some change in morphology, hence Hemimetabola.

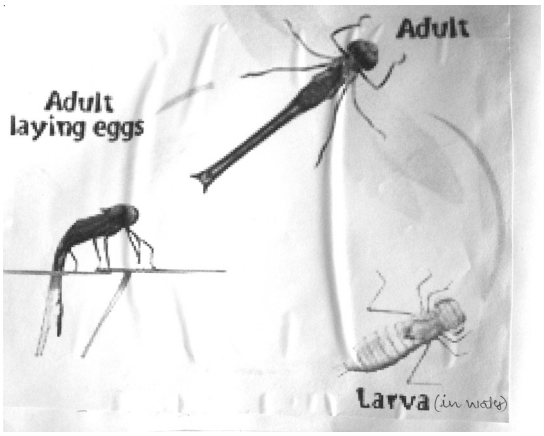
eg: Grasshopper, Plant bug, Bed bug, Dragonfly.



Life cycle of Grasshopper.



Life cycle of bed bug- Incomplete metamorphosis

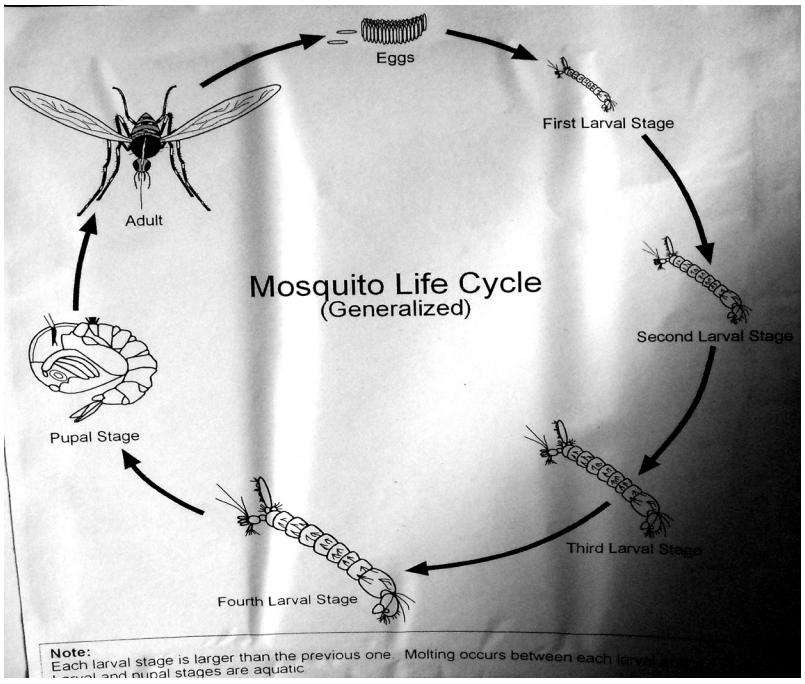


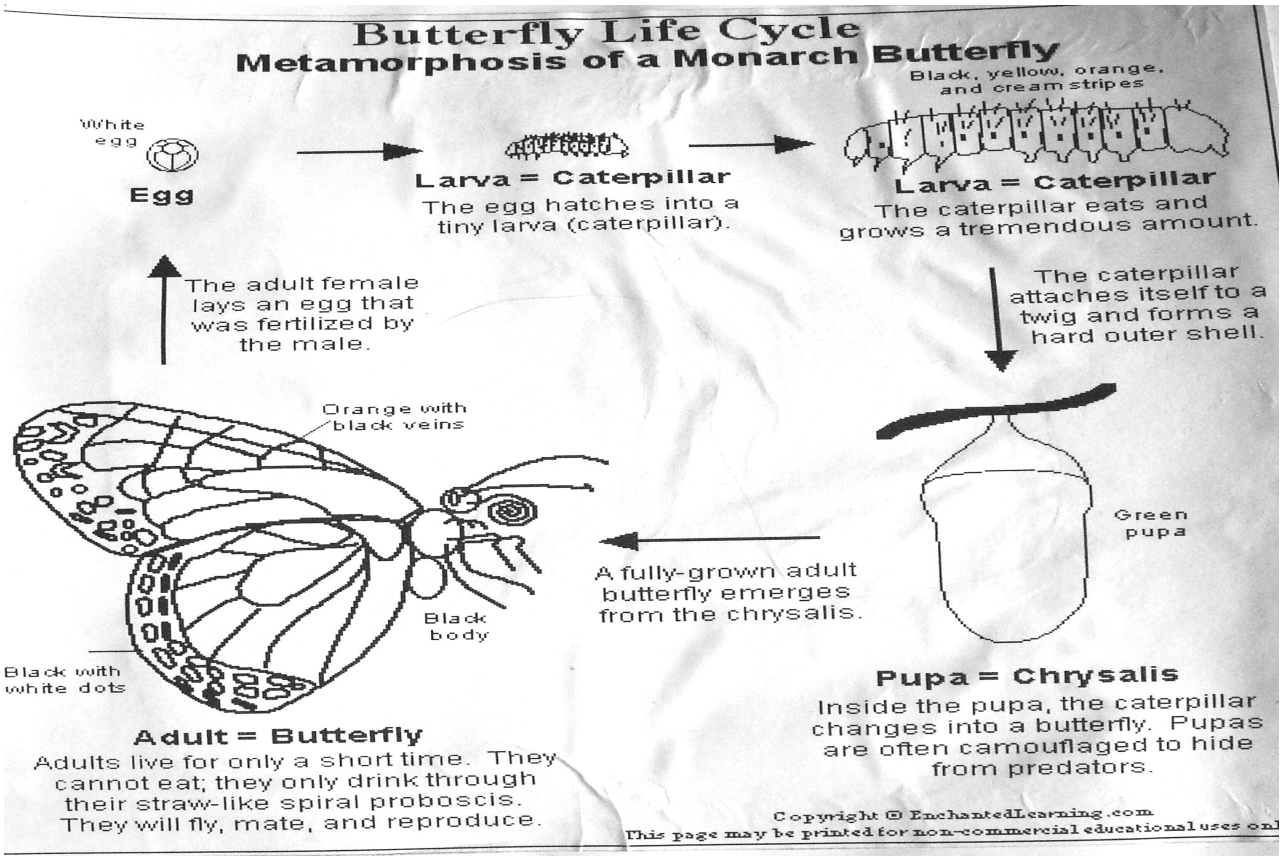
Life cycle of dragonfly – Incomplete metamorphosis.

Complete metamorphosis (Holometabola) :

From the egg hatches larva which is morphologically very different from the adult. It grows through number of instars. After full growth it changes to pupa. During pupal stage the larval structures get metamorphosed into adult structures which is a major change in morphology, hence complete metamorphosis.

eg: Wasps, Ants, Flies, Bed bugs, Beetles, Butterflies, Moths, Mosquitos.

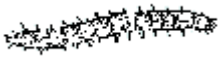
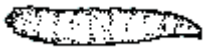


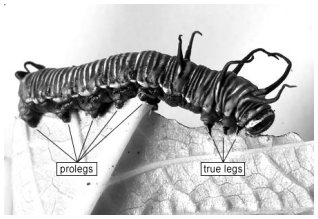


Types of Larvae and Pupae

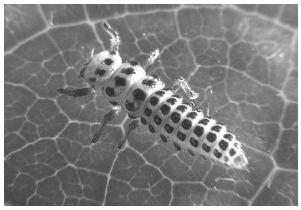
Gayatri Oak and Suyog Sawant
Department of Zoology, B.N. Bandodkar College of Science, Thane.

Holometabolous insects show *complete metamorphosis*, which distinguishes the Endopterygota and includes many of the most successful insect groups. In these species, an egg hatches to produce a larva, which is generally worm-like in form, and can be divided into five different forms; eruciform (caterpillar-like), scarabaeiform (grublike), campodeiform (elongated, flattened, and active), elateriform (wireworm-like) and vermiform (maggot-like)

Appearance	Larval Type	Common Name	Description	Examples
	Eruciform Polypod larva.	Caterpillar	Body cylindrical with short thoracic legs and 2-10 pairs of fleshy abdominal prolegs	caterpillars of Moths and butterflies
	Campodeiform Oligopod larva.	Crawler	Elongated, flattened body with prominent antennae and/or cerci. Thoracic legs adapted for running	Larvae of Lady beetle, lacewing
	Scarabaeiform Oligopod larva	White grub	Body robust and "C"-shaped with no abdominal prolegs and short thoracic legs	Larvae of June beetle, dung beetle
	Elateriform Oligopod larva	Wireworm	Body long, smooth, and cylindrical with hard exoskeleton and very short thoracic legs	Larvae of Click beetle, Flour beetle
	Vermiform Apodus larva	Maggot	Body fleshy, worm-like. No head capsule or walking legs	Larvae of House fly, flesh fly



Polypod larva (Caterpillar)

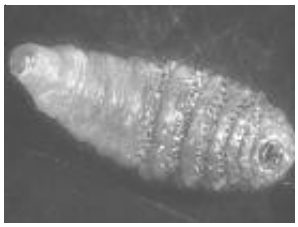


Oligopod larva.

Firefly larva ventral view. (Oligopod – Campodeiform larva)

Larva of Rhinoceros beetle (Oligopod-Grub)

Wire worm (Oligopod larva) Of click beetle



Botfly Apodus larva - Maggot

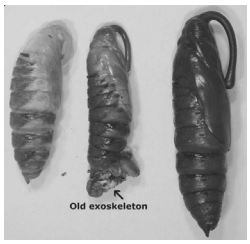
Legless (Apodus) Larva of wasp

Pupae :

Pupae can be grouped into one of three categories based on physical appearance:

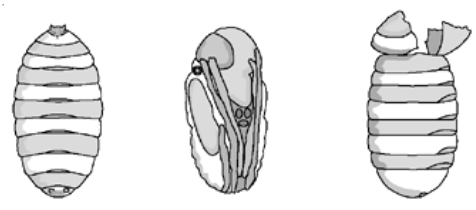
- **Obtect** pupae have appendages fused to the body
- **Exarate** pupae have appendages free from the body
- **Coarctate** pupae are contained within the last larval exoskeleton, the puparium.

Appearance	Pupal Type	Common Name	Description	Examples
	Obtect	Chrysalis	Developing appendages (antennae, wings, legs, etc.) held tightly against the body by a shell-like casing. Often found enclosed within a silken cocoon.	Butterflies and moths
	Exarate	None	All developing appendages free and visible externally	Beetles, Lacewings
	Coarctate	Puparium	Body encased within the hard exoskeleton of the next-to-last larval instar	Flies



Obtect pupae of Butterfly

Exarate pupa of honey bee.



Pupal stage of the house fly.(Coarctate pupa)- A) Puparium ("pupal case") showing remains of the posterior and anterior spiracles of the larval stage. B) Pupa which develops inside the puparium. C) Puparium after adult fly has emerged through the anterior split

Life Cycle of Butterflies

Pushya Francis, Rufina Rodrigues, Kirti Shivsharan, Harshada Adkar, Prachi Sawant
Department of Zoology, B.N. Bandodkar College of Science, Thane.

Life Cycle Of Painted lady Butterfly

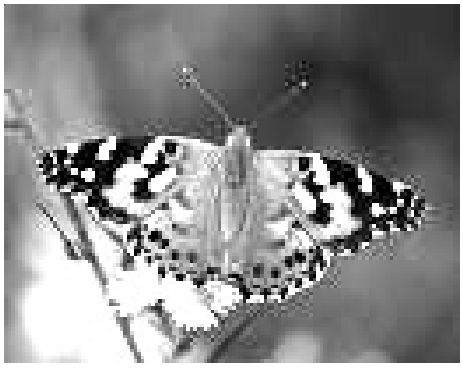
The Painted Lady Butterfly is found all over the world. It migrates, moving to milder climates for the winter months. The Painted Lady has a life cycle showing complete metamorphosis which takes about 23 days to complete. The Painted Lady lays its eggs on plants. One type of plant they prefer is the Malvacae plant the eggs are green and shaped oval. They are about 1 mm large. After the larva emerges from the egg it sometimes eats the home it has just left.

During the larval stage the larva or caterpillar is a very big eater. It stays near the plant where it was hatched, eating mostly leaves. Besides the Malvacae plants it eats thistles, nettles, and sunflowers. This stage takes about 4 weeks to complete.

The caterpillar's body has thirteen body segments and eight pairs of legs. The three pairs nearest the head become adult legs. The other 'false legs', are used for climbing and are shed when the larva goes through the last of the four to six molts it has during its life cycle. When the caterpillar grows too large for its skin, the skin splits up the back and the caterpillar re-emerges.

At the final molt the caterpillar crawls to a safe place and hangs upside down from a branch or leaf. The larva spins thread and attaches its tail to its resting place. In about 24 hours the skin splits down the back. Under this is the chrysalis, which hardens and becomes a golden color. This casing protects the life inside. The Painted Lady stays in this state for 7 to 10 days.

When the chrysalis splits and releases the butterfly, air is pumped into the wings, filling them with blood and unfolding them. The painted Lady has orange, white, brown, and black colors on the top wing and white, brown, tan, black, blue, and purple colors on the bottom part of the wings



Painted Lady

Life cycle of Tailed Jay-

Tailed Jay is now very common at low elevations and regularly seen in gardens and urban areas due to its food plant, *Polyalthia longifolia* (False Ashoka or Mast Tree), being widely used as an ornamental tree. These are strong and restless fliers; they are very active butterflies and flutter their wings constantly even when at flowers. The butterflies generally fly among the tree-tops but descend to ground level in search of flowers or host plants. Because of their relatively fast life cycle (just over one month from egg to adult), Tailed Jays are multivoltine and may produce up to 7–8 broods per year. It has been noted in one instance to be attracted to lights at night.

The eggs are pale yellow and are laid singly on the underside of young leaves, and hatch after 3–4 days. Young larvae are dark yellowish green with a pale yellow band in the middle of the abdomen. From the head, which is moderately large, the body increases in thickness rapidly to the 4th or 5th segment and then tapers gradually down to the tail. It has four pairs of spines. The colour is at first smoky-black, but at the last moult becomes a light clear green faintly marked with lines of a darker shade. The fully grown larva is green, fusiform and having small black spots. It has a pair of osmeterium and black spines on each thoracic segment, the third pair being orange-yellow. A fourth pair is situated on the last segment. The caterpillars undergo five instars over a period of 15–16 days, during which many are attacked by parasitoid wasps.

The pupae are green or brownish. They are found attached on the underside of leaves; sometimes on the upper side, and are held in place with a body girdle. The pupal stage lasts for 13–14 days. The horns are tipped with rusty brown.

Tailed Jay

Larva of Tailed Jay.

Fully grown larva of Tailed Jay.

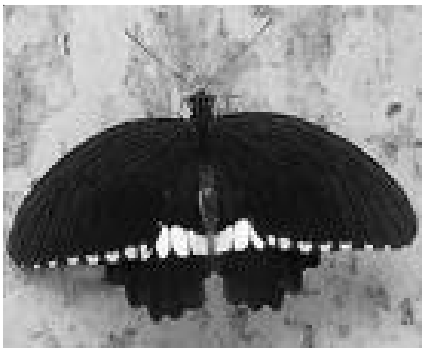
Pupa of Tailed Jay.

Life cycle of common mormon

Common Mormon is a gorgeous beauty flying restlessly, moving from the Curry Leaf Plant (Murraya koenigii) to the Annona squamosa (Custard Apple) tree, then back again to the Curry Leaf briefly and settled on the Pigeon Berry (Duranta repens). It is a very common species of the Swallowtail Papilionidae family with a prominent tail on its hind wings. An interesting polymorphic butterfly that is well-known for its ingenious mimicry to conceal and protect itself from predators.

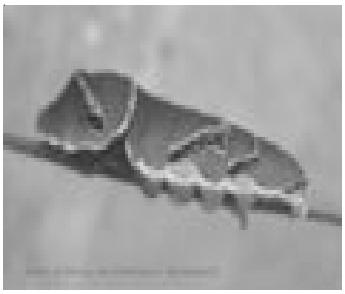
The females perch on an exposed branch with wings open or closed. They are courted by the males who approach from behind and slowly and elegantly settle into position. The eggs are laid singly on top of the leaves. They are round and yellow to light-orange in colour. The Common Mormon caterpillar has a black and white oblique band on the 8th and 9th segments and deep red osmeterium and yellowish-brown head. The Common Mormon caterpillars are heavily parasitized by Chalcid wasp, with over a hundred tiny wasps eventually emerging from each Mormon pupa.

The pupa is located on underside of leaf and twigs. The pupa is light green and unmarked. It has two projections to the front on its head and also one on its thorax



Common Mormon

Egg of Common Mormon



Larva of Common Mormon

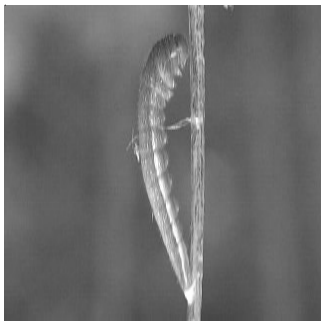
Pupa of Common Mormon

Orange tip butterfly. (American species)

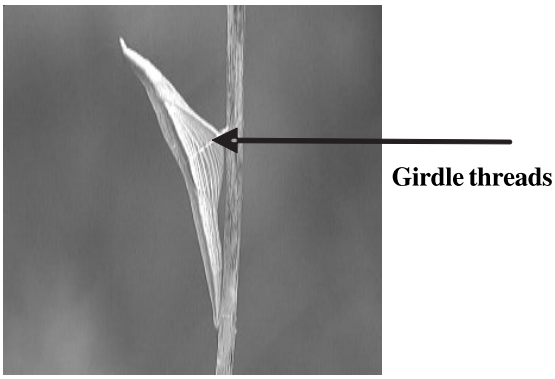
Egg ofOrange tip

Life cycle of orange tip –

The Orange Tip is a butterfly in the Pieridae family,so named because of the males bright orange tips to his forewings. The female lays her eggs on the flower heads of Cuckooflower, Cardimine pratensis and Garlic Mustard and occasionally other species of wild Crucifers. The eggs are white to begin with but change to a bright orange after a few days before darkening off just before hatching. Eventually a small caterpillar hatches from the egg. The caterpillar is an eating machine. It has to build up enough energy so it can change into a butterfly. When the caterpillar is big enough it finds a place to change into a chrysalis. It uses silk to secure itself to a strong twig. While it is a chrysalis the energy that caterpillar stored up is used to make amazing changes that create a butterfly. Just before the finished butterfly is ready to come out you can see its new wings in the chrysalis. The butterfly forces its way out of the chrysalis and crawls up to the top of the twig. The butterflies first minutes of life are a dangerous time because its wings are soft and it cannot fly away if something tries to eat it. When blood has been pumped into the wings and they have dried out the butterfly takes to the air to begin the life cycle again.



Larva of Orange tip ready for pupation.



Pupa of Orange tip.

लाल कुंभार माशीच्या पाळणा घरी

डॉ. पु. वि.जोशी
गृहकल्प अपार्टमेंट, कर्वे रस्ता, पुणे - ४

निसर्गाने माझ्या मनामध्ये कुतूहलाचे बीज रोविले. ते जन्मतःच की त्या अगोदर माहिती नाही. पण ते बीज माझ्या चेतापेशींमध्ये रूजले, वाढले, खरे तर माझ्याच नाही तर प्रत्येकाच्या मनामध्ये निसर्गाने हे बीज रोविलेले असते मी या कुतूहलास पकडून ठेविले आणि त्याच्या मदतीने अमुक अमुक गोष्ट कशी घडते याचा शोध घेऊ लागलो. मन त्यात रमू लागले. माध्यमिक विद्यालयात असताना माझे वाचन वाढले. मी विद्यालयाच्या नियतकालिकात लिहू ही लागलो. त्यामुळे वाचन अधिक वाढले.आजुबाजूच्या पक्षी, वनस्पती, कीटकांबद्दल नीट निरीक्षणे करावयाची व ती नोंदवहीत लिहून ठेवायची अशी मला सवयच लागली. मला लाल कुंभार माशीच्या पाळणाघराबद्दल / घरटयाबद्दल सांगावयाचे आहे.

लाल कुंभार माशी पाळणाघर बांधावयाची जागा शोधण्यामध्ये खूपच जागरूक असते. पाळणाघर बांधावयाची जागा निवडताना कोणाच्या सहजपणे दृष्टीस पडणार नाही, कोणाच्या सहजपणे हाती लागणार नाही, शिकारी प्राणी सहसा तेथे पोहोचणार नाहीत अशी जागा अनेक ठिकाणी अनेक फेऱ्या मारून ती शोधते आणि तेथे काळजीपूर्वक घर बांधण्यास सुरूवात करते. तिचे हे घर वेगवेगळया अनेक दालनांचे मिळून असते. एक दालन बांधण्यास तिला खूप वेळ लागतो. खूप श्रम करावे लागतात .

कुंभारमाशीसारखे कीटक त्यांच्या पाळणाघरात पिल्लांना ती अंडयातून बाहेर पडताच त्यांना अन्न मिळावे म्हणून ते साठवून ठेवतात. हा साठाच त्यांची पिल्ले (अळया) फस्त करतात आणि वाढीस लागतात.कुतूहल म्हणून मी कुंभारमाशीची पाळणाघर बांधणी, पिल्लांना (स्वतःच्या अळीला) अन्न म्हणून त्या घराच्या दालनामध्ये तिने केलेली फुलपाखरांच्या अळयांची साठवण, कुंभारमाशीच्या अळयांची त्यांच्या त्यांच्या दालनात होणारी वाढ, काही दिवसांनंतर पूर्ण वाढलेल्या अळयांचे कोशावस्थेत झालेले रूपांतर आणि त्या कोशावरणातून पूर्ण वाढ होऊन बाहेर पडलेली सुरेख कुंभारमाशी या साऱ्या घटना मी स्वतः पाहिल्या आणि अभ्यासल्या.

ऑक्टोबरमधले दिवस होते. दीपावलीची सुट्टी लागली होती. सुट्टीत वाचण्यासाठी ग्रंथालयामध्ये पुस्तके धुंडाळत होतो. अचानक एका पुस्तकाच्या मागे काठ वळलेल्या गोलाकार तोंडाची, शेजारी शेजारी चिकटून बांधलेली, कुंभाच्या आकारासारखी दोन सुबक छोटी पाळणाघरे दिसली. एका कुंभाचे तोंड चपटया गोलसर चकतीने बंद केलेले होते. दुसऱ्या कुंभाचे तोंड उघडे होते. कुंभाची ही पाळणाघरे पाहून खूप आनंद झाला.पुढे दररोज दिवसातून किमान दोनदा तरी वेगवेगळया वेळी तेथे येऊन त्या कुंभांचे काय होते ते पहावयाचे ठरवले. रोज ग्रंथालयातील त्या जागी जाऊ लागलो, नोंदी करू लागलो. दुसऱ्या दिवशी साधारणपणे १२ च्या सुमारास ग्रंथालयातील त्या जागी गेलो तेव्हा दुसऱ्या कुंभाचे तोंड गोल चकतीने बंद केल्याचे दिसले. तिसऱ्या दिवशी दुपारी तीन वाजता गेलो तेव्हा तिसरे कुंभ दालन बांधून झाले होते. अनुक्रमाने दुसऱ्याच्या शेजारी तिसरे दालन बांधले जायला हवे होते, निदान तशी माझी कल्पना होती. परंतु ते दालन क्रमांक १ च्या उजव्या बाजूस चिकटून बांधलेले आढळले. त्याच दिवशी कुंभ क्रमांक ४ ही बांधून झाला होता. तो बांधला होता कुंभ क्रमांक २ च्या डाव्या बाजूस कुंभ क्रमांक २ ला चिकटून. मात्र चारही कुंभांची तोंडे एकाच बाजूस एकाच दिशेस तोंड करून होती. त्यादिवशी कुंभ क्रमांक ४ चे तोंड उघडेच होते. त्यात डोकावून पहावयाचे मनात होते. पण धजावलो नाही. त्याक्षणी लाल रंगाची मध्यम आकाराची गांधील माशी तेथे पंखांचा आवाज करीत आली. तिच्या पायांच्या मध्यभागी तिने स्वतःच्या तोंडात पकडलेली फुलपाखराची अळी वळवळत होती. आता मात्र मी त्या पुस्तकापासून लांब उभा राहिलो आणि पुढे काय होते ते पाहू लागलो.गांधीलमाशी कुंभ क्र. ४ मध्ये शिरली होती.काही मिनिटांनी ती बाहेर आली पण तिच्या तोंडात फुलपाखराची अळी नव्हती.याचा अर्थ गांधीलमाशीने ती अळी कुंभामध्ये ठेवली असावी असा मी केला.चवथ्या दिवशी दुपारी तीनच्या सुमारास मी पुढील निरिक्षण नोंदण्यासाठी तेथे गेलो तेव्हा कुंभ क्रमांक ४ चे तोंड पूर्वीच्या पध्दतीने बंद केल्याचे आढळले. त्याचबरोबर कुंभ क्र. ५ ही बांधून पूर्ण झाल्याचे दिसले आणि कुंभ क्र. ६ चे बांधकाम नुकतेच सुरू झाले असावे अशा स्थितीत होते. क्र.५ चा कुंभ कुंभ क्र.४ ला जोडून बांधला होता. कुंभ क्र. ६ ची बांधणी कुंभ क्र. ४ आणि ५ यांच्या डोक्यावर मधोमध झाली होती. ही बांधणी पूर्ण झाली नसल्यामुळे ज्या अवस्थेत होती त्यावरून असे लक्षात आले की दोन कुंभांमध्ये असलेली अथवा एका वर एक अशा पध्दतीने बांधलेल्या कुंभाची खालची बाजु सामायिक असते. पाचव्या दिवशी ही मी चारच्या सुमारास त्या आता आवडू लागलेल्या ठिकाणी निरीक्षणासाठी गेलो असता कुंभ

क्र. ६ चे बांधकाम पूर्ण होऊन त्याचे तोंड बंद केल्याचे दिसले कुंभ क्र.७ ही बांधुन पूर्ण झाला होता. कुंभ क्र. ८ चे बांधकाम अपूर्ण स्थितीत झाले होते.परंतु ज्या जागी ते बांधले होते.त्या जागेने मला आश्चर्यचकित करून सोडले. कुंभ क्र. ७ कुंभ, क्र. ३ आणि कुंभ क्र. १ च्यावर मधोमध बांधला होता. कुंभ क्र. ८ , कुंभ क्र. २. आणि कुंभ क्र. ४ यांच्यावर मधोमध कुंभ क्र . ६ ला जोडून बांधलेला होता. या माझ्या निरीक्षणाच्या वेळी लालसर कुंभार माशीच्या येण्या जाण्याच्या खेपा चालू होत्या. रिकाम्या कुंभातून बहुधा फुलपाखरांच्या अळया भरण्याचे काम / कर्तव्य चालू होते. सहाव्या दिवशी सुमारे तीन वाजता मी मला लोभात टाकणाऱ्या त्या जागी गेलो तेव्हा लाल कुंभार माशी क्र.९ चा कुंभ बांधण्यात गर्क होती. क्र.९ चा कुंभ तिने कुंभ क्र. १ व कुंभ क्र. २ च्या डोक्यावर कुंभ क्र. ७ आणि कुंभ क्र. ८ यांच्यामधील निरूंद जागेत बांधावयाला घेतला होता. मी साधारणपणे अर्धातास हे घडणारे अनुपम शिल्प पाहण्यात गुंग झालो होतो.

सातव्या दिवशी दुपारी दोनच्या सुमारास तेथे गेलो असता या सर्व कुंभांवर बाहेरच्या बाजूने चिखलाचे लिंपण चालू असल्याचे दिसले. पाळणाघरांच्या दालनांचे बांधकाम संपल्याची ती दुःखद निशाणी होती. ग्रंथालयातील सेवक मामांना हे लिंपण मी सांगेपर्यंत तेथून काढून न टाकण्याची विनंती केली. मग अनियमितपणे अधून मधून त्या जागी जाऊन लिंपणात फरक पडलाय किंवा कसे ते पहात असे.

त्या दिवसात आदित्यने मला बऱ्याच चांगल्या स्थितीत असलेली, लाल कुंभार माशीची तीन पाळणा दालने आणून दिली त्यातील एका दालनात आतल्या भिंतीला, रेशीमधाग्याने लटकणारे एक लंबगोल अंडे आणि फुलपाखराच्या सुप्तस्थितीत असलेल्या तीन अळया आढळल्या. दुसऱ्या दालनामध्ये फुलपाखराची एक अळी आणि पाय नसलेली एक छोटीशी अळी मिळाली. ही अळी बहुधा लाल गांधीलमाशीची असावी. तिसऱ्या दालनामध्ये एक कोशावस्था आढळली असावी. प्रत्येक दालनामध्ये मिळालेल्या या गोष्टी तीन वेगवेगळया होमिओपाथीच्या मोठया तोंडाच्या काचेच्या बाटल्या असतात ना? तशा बाटल्यात स्वतंत्रपणे ठेवल्या.तीनही बाटल्यांची तोंडे कापसाच्या बोळयाने बंद केली.त्यानंतर प्रत्येक दिवशी त्यात घडणाऱ्या घटनांची प्रौढ गांधीलमाशी बाहेर पडेपर्यंत (३३ दिवस) न चुकता नोंद केली.केलेल्या नोंदीचा गोषवारा तुमच्याही संशोधक वृत्तीला चालना देईल अशी खात्री आहे. (तक्ता पहा).

आदित्यने आणून दिलेल्या पाळणाघराची निरीक्षणे नोंद करण्यात गुंतून गेल्यामुळे मी ग्रंथालयातील त्या पाळणाघरांचे निरीक्षण करावयास गेलोच नव्हतो. गेलो तेव्हा लिंपणाला आठ भोके पडल्याचे दिसले. बाकी लिंपण मात्र सुस्थितीत होते.त्याला काहीच झाले नव्हते. मागील निरीक्षणाच्या नोंदी असे सांगत होत्या की कुंभार माशीने नऊ कुंभ दालने बांधली होती. परंतु भोके मात्र आठ होती. याचा अर्थ आठ दालनातील कुंभार माश्या तोंडावरील चकती फोडून बाहेर पडल्या. नवव्या कुंभातील गांधीलमाशी बाहेर पडू शकली नसावी. असे का झाले असावे हे पाहण्यासाठी मी ते लिंपण पुस्तकाच्या आवरणावरून अलगद काढून घेतले. तेव्हा लिंपणाची मागील बाजू माती वा चिखलाने बांधून घेतली नसल्याने उघडी असल्याचे दिसले. त्यातील नवव्या कुंभाचे दालन पूर्णतः मोकळे असल्याचे आढळले. मनामध्ये अनेक प्रश्न उभे राहिले. आदित्यने दिलेल्या दालनांकडे लक्ष राहिल्याने आपण इथल्या निरीक्षणांना मुकलो याचे खूप वाईट वाटले. परंतु आजपर्यंत केलेल्या निरीक्षणांचा आढावा घेण्याचे ठरविले. या आढाव्यात असे आढळले की. लाल कुंभारमाशीने बांधलेली नऊच्या नऊ पाळणादालने बाहेरच्या बाजूस वळणाऱ्या काठांच्या कुंभांसारखी होती. कुंभांच्या जागा अनुक्रमानुसार एका ओळीत नव्हत्या. त्यांची बांधणी एकावर एक अशी तीन मजल्यांची होती. त्यातील दालने अनुक्रमानुसार बांधलेली नव्हती. दोन कुंभांमधील आणि दुसऱ्या मजल्यावरील कुंभांच्या खालील भिंती सामायिक होत्या. सर्व दालनातील कुंभारमाशीच्या अळयांचे भक्ष्य केवळ फुलपाखरांच्या अळया हेच असावे.

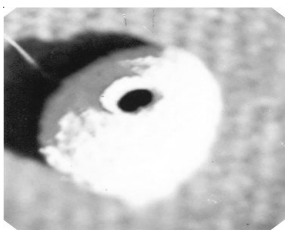
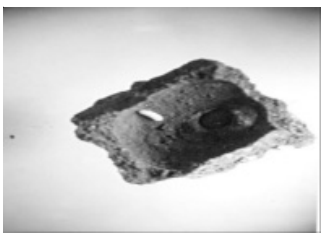
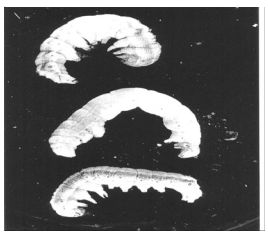
हा आढावा घेत असताना अनेक प्रश्न मनात आले.

१. कुंभांच्या बांधणीला अनुक्रम नसतो. कोठलाही कुंभ कोठेही बांधलेला दिसतो. त्या बांधणीला केवळ लहर असे म्हणायचे की कसे? दुसरीही कारणे असल्यास ती कोणती असावीत ?

२. ही कुंभारमाशी आपल्या पिल्लांसाठी (अळयांसाठी) केवळ फुलपाखरांच्याच अळया गोळा करते? एखाद्या खेपेस फुलपाखरांच्या अळया मिळाल्याच नाहीत तर काय होत असेल त्यावर मात करण्यासाठी ती काय उपाय करीत असेल? पिल्लांसाठीचे खाद्य अळया. तिचे स्वतःचे खाद्य काय असते ती पाळणाघरात राहात नाही हे तर समजले मग ती राहते कोठे हे समजलेले नाही. कोठे राहत असावी बरे? या सर्व प्रश्नांची उत्तरे मला मिळवायची आहेत.त्याचबरोबर आणखी निरीक्षणे असल्यास नोंदवायची आहेत. एकदा नव्हे, अनेकदा. त्याशिवाय आता नोंदवलेली निरीक्षणे

सर्वथा बरोबर आहेत की नाहीत हे समजणार नाहीत. ठाम निष्कर्षही काढता येणार नाहीत. अनेकदा निरीक्षणे नोंदवीत असता कदाचित, आता मिळालेली नाही अशी माहितीही मिळू शकेल. मनाचे समाधान होईपर्यंत या लाल कुंभारमाशीच्या पाळणा घरांची निरीक्षणे मी करीत राहणार आहे. तो प्रकल्प तर आहेच. संकल्पही आहे त्यातूनच एखादे छानसे संशोधन ? संशोधन ज्याला म्हणतात ते उभे राहणार आहे.

नोंद क्र.	जीवन चक्रातील अवस्था	अवस्थेची पूर्ण वाढ होण्यास लागलेले दिवस	अवस्थेची लक्षात घेण्याजोगी वैशिष्टये
१	अंडे	२	अंडे लंबगोल. रंग पांढरा रेशीम धाग्याने दालनाच्या आतील भिंतीस चिकटलेले.
२	अळी	६	अळी, पायविरहित, डोके इतर शरीर भागापासून स्पष्टपणे ओळखू येईल असे.
३	पूर्वकोश	८	तोंडातून बाहेर पडणाऱ्या लाळेचा स्त्राव काचेच्या आतील बाजूस फासण्यासाठी. पहिले काही दिवस हालचाल केली. नंतर हालचाल थांबून अवस्था स्वस्थ पडून राहिली.
४	कोश	१७	तिसऱ्या दिवशी डोळ्यांचा रंग लाल, चौथ्या दिवशी तो लालसर तपकिरी किंवा काळसर झाला. दहाव्या दिवशी वक्षाच्या खंड भागावर काळसर तपकिरी रेषा आणि रूंद पोटाच्या दुसऱ्या खंडभागावर आडवा काळपट पट्टा उमटला. चवदाव्या दिवशी रूंद पोटाचा भाग लांबसर झाला. शरीराचा पिवळट पांढरा रंग हळूहळू बदलला जात १७ व्या दिवशी लाल झाला.
५ काढुन	प्रौढ		पंख, पाय शरीरापासून सुटे झाले. हालचाल करू लागतात. पंखामध्ये हवा भरल्याने ते आवश्यक तेवढे विस्तारलेले. परंतु प्रौढ (यावेळी काचेच्या बाटल्यांची तोंडे, कापसाचे बोळे टाकून, मोकळी करून ठेवली होती. त्यामुळे प्रौढ गांधीलमाशी उडून जाऊ शकली.) गांधीलमाशी चार दिवस एका कुशीवर पडून राहिली. दिवसाच्या अखेरीस अथवा पाचव्या दिवशी उन्हे पडल्यावर काचेच्या बाटली बाहेर येऊन ती पंख पसरून उडून गेली.


Bombardier Beetle (Tribe: Brachini)

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Taxonomy

Kingdom Animalia , Phylum Ahropoda, Class Insecta, Order Coleoptera Family Adelphaga, Subfamily Paussinae, Tribe Brachini Genus *Brachinus*

Common Name Bombardier Beetle

Identification:- As Poetker (2003) describes, the bombardier beetle, like all members of the insect order Coleoptera, has two elytra (sheaths) over its wings, although the wings themselves are considered vestigial in the American species and rather useless for flying. To compensate for this inability to escape by flying away from predators, the beetle possesses a rather interesting apparatus for defending itself against predators, which will be elaborated on later. All of the other characteristics of insects in general (six legs; two antennae; body segmented into head, thorax, and abdomen; etc.) are present (Isaak, 1997).The only genus, *Brachinus* (described in 1983), 4-15 mm in length, contains about 40 species which occur over much of North America. All have a narrow head and prothorax; legs are reddish yellow; and elytra bluish or black (White, 1983).

Habitat:- As Poetker (2003) describes, bombardiers can inhabit a fairly wide variety of environments (including: desert, dune, savanna, grassland, chaparral, and forest) as long as there is sufficient moisture to allow for good places to lay their eggs. Bombardier beetles of all types generally live in temperate zone woodlands or grasslands (Isaak, 1997; Salleh, 1999).

Distribution:- Poetker (2003) states, "Bombardier beetles can be found on most continents around the world" (as cited in Isaak 1997; Salleh 1999).

Natural History:-Life Cycle:- As Poetker (2003) describes, any place will do for a ground beetle to lay its eggs, so long as it's out of the way of most predators but not too far away from a good food source. Small underground tunnels or cracks in rotting wood are viable places, as are the decomposing remains of other living things (which quite often serve as the food source). The egg hatches into the larval stage, which begins taking in nourishment from the food source and occasionally molting. After it sheds its skin for the last time, it metamorphoses into a pupa, the stage at which the juvenile looks most like the adult which it will eventually become. At the end of the papal stage, the pupa sheds its skin and a new adult bombardier beetle emerges. Ground beetles tend to live for several weeks, during which they have ample opportunity to mate and pass on their genes (Shetlar, 1988). Larvae of these species are parasitic (White, 1983).

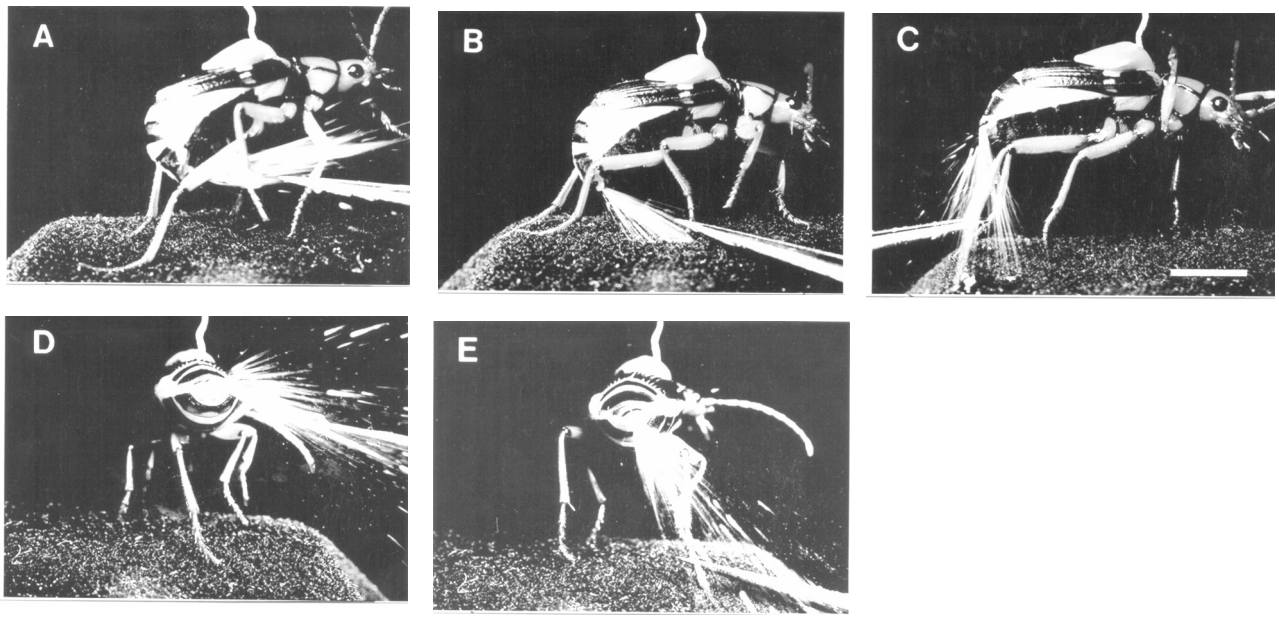
Diet:- As Poetker (2003) describes: a member of the family Carabidae, more commonly known as the ground beetles, the bombardier beetle quite naturally shares some of the habits of its family, and like most other ground beetles, tends to come out at night to prey on smaller insects. Unlike most other ground beetles, however, the bombardier is rather gregarious, so when not wandering around looking for food (thus usually during the day) it will congregate with others of its kind in dark, damp places such as hollow logs (Eisner, 2000; Shetlar, 1988).

Pest Status:- Poetker (2003) states, "*Brachinus*, like nearly all the species in the family Carabidae, is a predator, and eats a number of other insects that are agricultural pests" (as cited in Shetlar, 1988).

Defense Mechanism:- The Beetle will only fire only when directly touched. The spray's temperature is very close to 100 degrees Celsius. It can spray more than 20 times

before it has exhausted its secretary reserves. Benzoquinones are what compose the expelled substance. It was discovered though that the beetle does not store the Benzoquinones as such in glands, but instead stores chemical precursors called hydroquinones It stores the hydroquinones in a reservoir together with hydrogen peroxide; they don't interact in this mixture, but if appropriate enzymes are added, the two substances react (explosively). The enzymes are of two kinds of chemicals: catalases and peroxidases. The moment reservoir fluid enters the reaction chamber, the catalases promote the breakdown of hydrogen peroxide into oxygen and water, while the peroxidases promote the oxidation of the hydroquinones to Benzoquinones (Eisner, 2003). As Poetker (2003) describes, added to this, the beetle can rotate the end of its abdomen 270 degrees in any direction, which allows for an impressive "firing range." In effect, the beetle can spray in whatever direction the predator comes from, a decided advantage (Dawkins 1985; Eisner 2000; Salleh 1999).

BOMBARDIER BEETLE – FIRING HOT AND EXPLOSIVE FLUID FOR PROTECTION



Screwworm Fly

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Classification

Screwworms belong to the Class *Insecta,* Order *Diptera*, (the true flies), and the Suborder *Cyclorrhapha,* (which includes the common house fly).

Figure 1

What is screwworm fly?

Its scientific name is *Cochliomyia hominovirax.*

The screwworm fly is about twice the size of a regular house fly and can be distinguished by its greenish-blue color and its large reddish-orange eyes. (Figure 1)

Screwworm larvae distinguish themselves from other species by feeding only on the living flesh, never dead tissue. Once a wound is infested, the screwworm can eventually kill the animal or human literally eating it alive.

Why is it called as screwworm fly?

The fly got name screwworm because larvae have screw like appearance and they bury down in the living tissue like a screw. They have prominent rings of spines around each segment of the body that look like the threads of a hardware screw. These spines are directed posterior ward and help anchor the larvae into the wound. Also, when a wound that is infested with the larvae is disturbed (e.g., scratched) the larvae actually burrow deeper into the wound. Even more significant is the fact that screwworm maggots orient themselves in the wound perpendicular to the surface, much like a screw driven into wood.

Secondly, let's look at the name *Cochliomyia hominivorax*. "Hominivorax" is Latin for "human-eating." All warm-blooded animals, including humans, are at risk of developing screwworm myiasis.

Types

- Types of screwworm include the Old World Screwworm (*Chrysomya bezziana*) and the New World screwworm (*Cochliomyia hominivorax*), sometimes called the American screwworm or the American primary screwworm.
- In addition, a nonpathogenic secondary screwworm (*Cochliomyia macellaria*) resembles the American primary screwworm, but behaves much differently. In fact, the secondary screwworm requires a pre-existing wound for animal infestation, and it usually develops in dead carcasses.

What does screwworm do?

The screwworm larvae can infest wounds of any warm-blooded animal, including human beings. Infestations can occur in any open wound, including cuts, castration wounds, navels of newborn animals, and tick bites. The wounds often contain a dark, foul-smelling discharge.

Life cycle

They complete their life cycle in a span of 31 days.
There are 4 stages in life cycle of screwworm fly.
They are as follows*:*
1. egg 2.larva 3. pupa 4.adult

Figure 2:Eggs

1. Egg

The adult female deposits her eggs in fresh wounds or on mucous membranes associated with natural body openings.

Female lays an average of 200 eggs per egg mass, and 1-4 egg masses in an average lifetime.

The eggs hatch within 24 hours of being deposited in the living tissue.

Figure 3:Larva

2. Larva

The parasitic larvae, commonly called maggots, emerge, feeding on living flesh.

As they feed, the larvae burrow headfirst deeper into the tissue, enlarging the wound and destroying tissues.

In the process, the fly larvae produce a brownish-red, foul smelling discharge that subsequently attracts more gravid females to lay their eggs.

As a result, one wound may contain as many as 3000 larvae.

While in the tissue, the larvae molt through a total of 3 larval stages.

3. Pupae

After about 5-7 days of feeding and maturing, the larvae leave the host, dropping down to the ground to pupate in the soil..

The integument of the 3rd stage larva hardens, forming a case-like pupal sac called a puparium.

Within the puparium the larva undergoes complete metamorphosis, becoming a pupa from which an adult emerges after approximately 1-3 weeks.

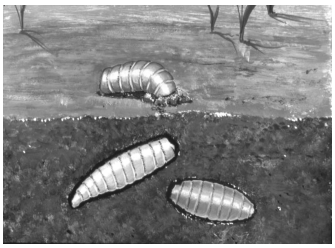

Figure 4 : Pupae

4. Adult

Within 1-3 days of emergence from the puparium the adults mate.

About 4 days after mating, the female is ready to lay her eggs.

Adults usually live approximately 2-3 weeks.

Within this time, they can travel great distances on their own

Figure 5: Adult

What is myiasis?

Myiasis is the invasion of living tissue by fly larvae.

The pocket-like wounds are formed by the larvae while feeding. The sick, irritated animal sometimes runs violently causing accidents. If not taken care of in time the animal may get secondary infection and die. From the wounds on head, the larvae can go into sinuses and brain also,causing high fever and death. Figure 6 to Figure 9 show some cases of myiasis.

Figure 6 : Myiasis of vulva

Figure 7: Myiasis on the back

Figure 8: Myiasis of eye

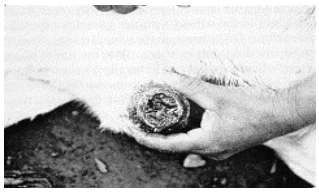

Figure 9 : Myiasis of navel

Who is at risk?

All warm blooded animals, like horses, Pigs, Dogs, Cattle, Sheep, Goat, Cats, Wild animals, as well as Human

Common areas of infestation are wounds of animals, mucous membrane of animals, natural openings of animals and navel of a new born calf, wounds on head and other parts of the body.

Treatment

Treatment for Screwworm involves killing and removing larvae.The wound should be treated with an effective and approved pesticide and antibiotics may be given to treat secondary infection.

Prevention

The best way to prevent screwworm myiasis is to prevent introduction by monitoring wounds and treating infested wounds with insecticides. In the U.S., treatment and prevention involve prompt application of insecticides to the patient as well as decontamination and disinfection of current and past environments, and possibly release of sterile males. In areas where screwworm myiasis is endemic, procedures such as dehorning, branding, and ear tagging should be limited to the colder seasons to decrease the chance of infestation.

Control and eradication

To produce sterile males for eradication efforts, once the larvae reach the pupal stage, they are irradiated by exposure to gamma rays, which cause dominant lethal mutations in the germ cells. Thus, the emerging male flies are sterile but are normal in every other way. The pupae are placed into boxes after the irradiation. Once the flies emerge, they are loaded onto planes and released over infested areas. These sterile males will mate with the wild population of female screwworm flies, but these matings produce inviable eggs. Because the females only mate once in their lifetimes, when that mating is with a sterile male, no offsprings are produced

Petroleum Fly

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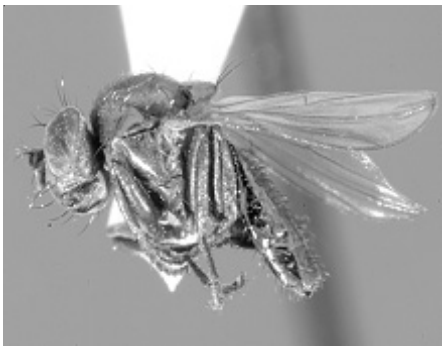

Petroleum fly *Psilopa petrolei* Coquillet, 1899, California.

Distribution: California oilfields.

Habitat: This is the only insect known whose larvae develop in seepages of crude oil.

Physical characteristics

Adults are small (0.08 inch[2 mm]), and their bodies are black and prunose except cheeks and sides of face, which are grayish. Eyes are hairy and wings are hyaline and tinged with gray on their costal (anterior) half. Larvae are elongate, reaching a length of 0.3–0.4 inch (7–10 mm). They breathe through spiracles on their posterior end, which are surrounded by four supporting fans of setae; the fans rest upon the surface of the oil and keep the spiracles above the surface.

Behavior

Larvae swim slowly, usually near or on the surface of the oil, although they can submerge for a considerable length of time. Adults remain near petroleum pools, hiding in the cracks in the soil, flying about and over the pools, and landing on the margin or on some projecting stone or stick within the pool. They can walk on the surface of the oil as long as no body part other than the tarsi comes in contact with the oil.

Feeding ecology and diet

The larvae feed on dead insects that have become trapped in the oil pools.

Reproductive biology

Mating behavior and oviposition are still undescribed. When ready to pupate, the larva leaves the oil and pupates on grass stems on the margins of the pool.

Conservation status: Not threatened.

Significance to humans

Crude oil is usually regarded as a very effective insecticide. Thus, petroleum flies are of interest to biotechnologists because they can provide information regarding the ability of organisms to resist the toxic effects of aromatic and petroleum compounds.

Potter Wasp

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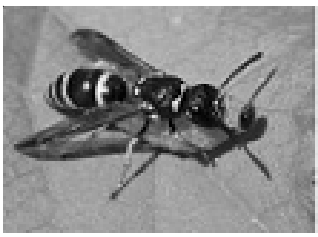
These wasps make nest out of mud. Hence they are called as potter wasp, "Kumbhar Mashi". They are also known as mason wasps. They make different type of nests. some are typical pot like whereas some wasps make the nest in ready tubular structures

Life-Cycle of Potter Wasp

Potter wasp adults collect small caterpillars (or other food organism such as spider etc.) to feed their young. They paralyze the prey organism & take them to the nest. The female wasp then lays egg, either hanging above the food organism or on the food organism. The larva that hatches from the egg, drops on the supplied food & starts feeding. The complete life-cycle may last from a few weeks to more than a year.the stages in the life cycle include egg, larva, pupa and adult (complete metamorphosis)



A potter wasp

Potter wasp laying egg in the pot cell.

Nest of potter wasp

The potter wasp makes nest out of mud.Each female constructs nests independently.She carries a droplet of water to a mud-collecting site and mixes it with dry clay earth, using her mandibles. The wasp's saliva may help to strengthen the dried mud. They then collect wood fibers to cover the mud nest. Some species make pot-shaped nests. However there are different types of nests.

Types of nests :

Tubular nest.

Series of pot like nests

Under ground nest.

Food & feeding habits:

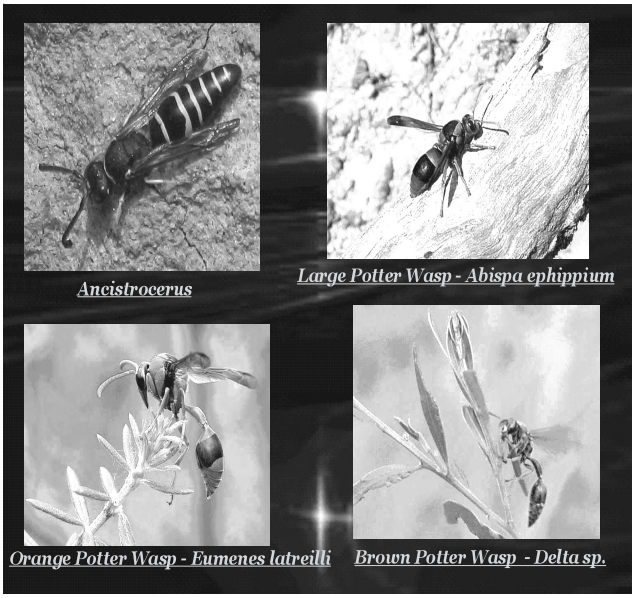
The adult potter wasp feeds on flower nectar. The larvae of potter wasp feeds on the paralyzed caterpillars, beetle larvae, spiders, etc.

Types in which they lay eggs:

Some species of potter wasp's lay egg in the opening of the cell, suspended from a thread of dried fluid. While some species lay egg on the paralyzed prey.

Species of potter wasp:

Potter wasps are medium- to large-sized wasps, 9 to 20 mm (0.35 to 0.79 in) long. They are black with white, yellow, orange, or red markings. There are different species.



Significance

Potter wasps are important in the natural control of pest insects (biological control)

Damage caused by potter wasp

Potter wasps rarely stings, however if stung symptoms are similar to bee stings which may cause serious allergic reactions in sensitive people.

Study of some Insects found in Panvel area.

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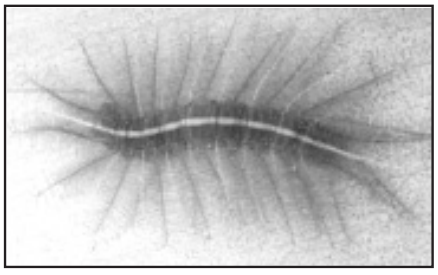
Water Scorpion: Any of various aquatic insects of the family Nepidae, having a large breathing tube projecting from the posterior part of the abdomen and inflicting a painful sting. They are commonly called **water scorpions** for their superficial resemblance to a scorpion, due to the modification of the legs, of the anterior pair for predation, and to the presence of a long slender process, simulating a tail, at the posterior end of the abdomen. sometimes called **needle bugs** or **water stick insects**

If disturbed, **stink bugs** will emit a pungent liquid, whose rancid almond smell is due to cyanide compounds. Their bodies are usually shield-shaped. The stink bugs have thick wing covers known as shields.

Many stink bugs and shield bugs are considered agricultural pest insects, because they can create large populations; they suck plant juices and damage crop production, and they are resistant to many pesticides.

The **Common Mormon** *Papilio polytes* is a common species of swallowtail butterfly widely distributed across Asia. This butterfly is known for the mimicry displayed by the numerous forms of its females which mimic inedible Red-bodied Swallowtails, such as the Common Rose and the Crimson Rose. The adults are often *tailed* like the forked tail of some swallows, giving the insect its name.

A colloquial name for the order is **"praying mantises"**, because of the typical "prayer-like" stance. Mantises are exclusively predatory and their diet usually consists of living insects; larger species have been known to prey on small lizards, frogs, birds, snakes, and even rodents.



The **Common Baron** (*Euthalia aconthea*) - often called simply "baron" - is a medium-sized nymphalid butterfly native to India and Southeast Asia. The Photo shows its larva which camoflages with the leaf.

True katydids are relatives of grasshopper and crickets. They grow two inches long and are leaf green or pink in colour. They have green colour, oval shaped wings with venation similar to leaf. Both male and female katydid make sound by rubbing their forewings.

Pyrrhocoride bug The red bug—a fairly common, gregarious, plant-feeding insect found mostly in the tropics and subtropics—is oval in shape and brightly coloured with red with striking patterns of yellow, red, black and white.

Scutelleridae are otherwise known as **shield-backed bugs**, a reference to the fact that their shield is continuous, not divided. Because bugs in this family are usually brightly colored, they are also known as **Jewel bugs**.

Death's-head Hawkmoth These moths are easily distinguishable by the vaguely skull-shaped pattern of markings on the thorax. They have the ability to emit a loud squeak if irritated. The sound is produced by expelling air from the pharynx, often accompanied by flashing of the brightly-colored abdomen in a further attempt to deter predators.

Danaid Eggfly, female This beautifuly colored Danaid Eggfly, female of the species mimics the Plain Tiger, *Danaus chrysippus* to avoid being eaten. The tiger butterflies are unpallatable and are common than these danaid eggfly butterflies

Aquatic Insects

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Introduction

Truly aquatic insects are those that spend some part or complete life cycle in the water, either living beneath the surface or skimming along on top of the water.

Sampling

Screens, nets, Artificial Substrate Samplers, Grabbing devices & dredges, Floating leaf is used. The insects are attracted to the leaf for feeding. Then that leaf along with the insects can be collected.

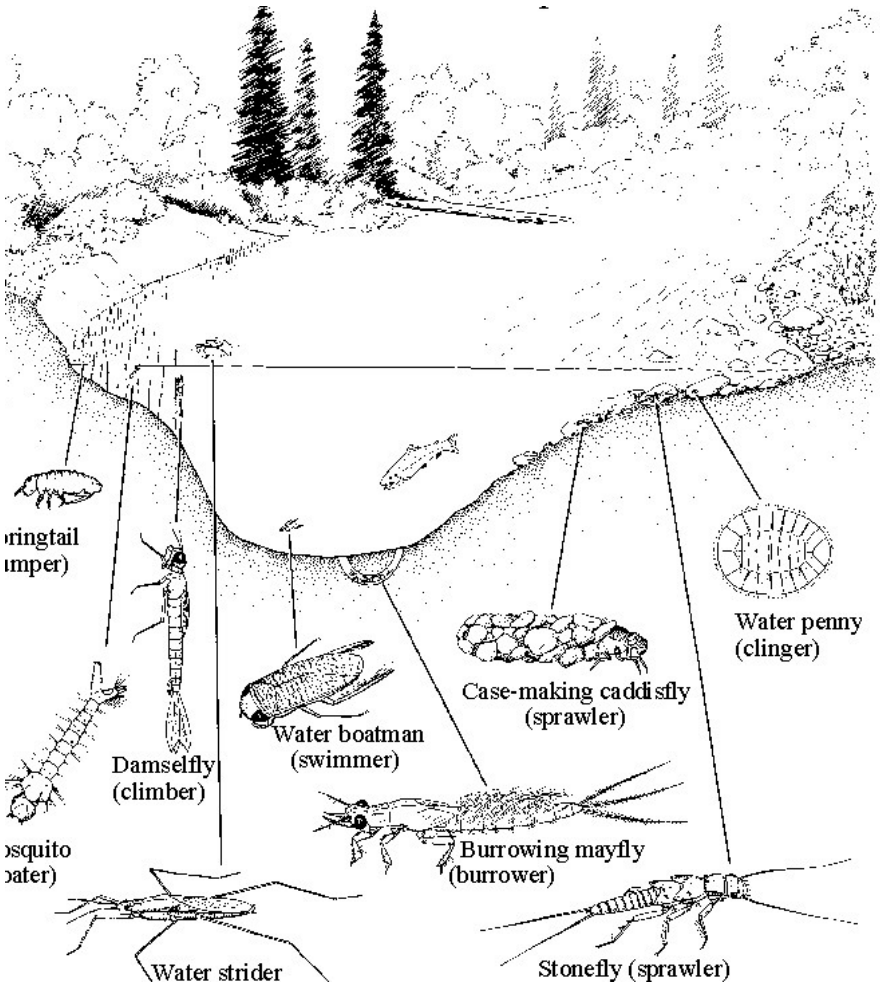

Fig. A : Habitat orientation of aquatic insects.

Classification

According to position in the habitat

1. **Jumper :** The insect jump over water surface. Ex: springtail.
2. **Skater :** They float on the water .Body is above the water Ex: Water strider.
3. **Floater :** The larvae float on the water. Ex: Culex larva.
4. **Climber :** They reside on stems of aquatic plants. Ex: Damselfly.
5. **Swimmer :** They swim in the water streams Ex: Water boatman.
6. **Burrower :** They burrow in the soft bottom of water streams. Ex: Mayfly nymph.
7. **Sprawler :** They crawl on or along the protected surface of the water streams Ex: Stonefly nymph.

According to characters:

(Orders)

1. **Collembola :** - Springtail.
2. **Ephemeroptera :** - Mayflies.
3. **Odonata :** - Dragonflies, Damselflies.
4. **Plecoptera :** - Stoneflies.
5. **Hemiptera :** - Water strider, Water boatman, water scorpion.
6. **Trichoptera :** - Caddis flies.
7. **Coleoptera :** - Water penny beetle, whirligig beetle
8. **Diptera :** - Mosquito (larvae and pupae)

Fig.1: Springtail

Order: Collembola Springtail.1. They are very small in size.2.They have evolved jumping device Composed of a furcula & tentaculum.3.This helps them to jump around the surrounding vegetation.

MAYFLIES.

Fig. 2: Adult Mayfly1.

They have 4 transparent wings, 2-3 tail filaments, short antennae & bulging eyes.2. The adults live for a short time .They just mate during flight and then they die.

Fig. 3: Mayfly Nymph3.

Nymphs are aquatic. They respire by gills on the abdomen. They are used as pollution indicator as they are very sensitive to low O_2 4. They are also used as bait for fishes.

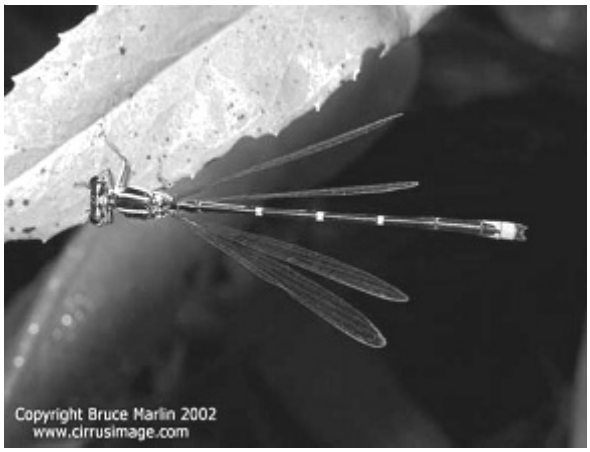

Fig. 4 : Damselfly

Fig. 5: Dragonfly

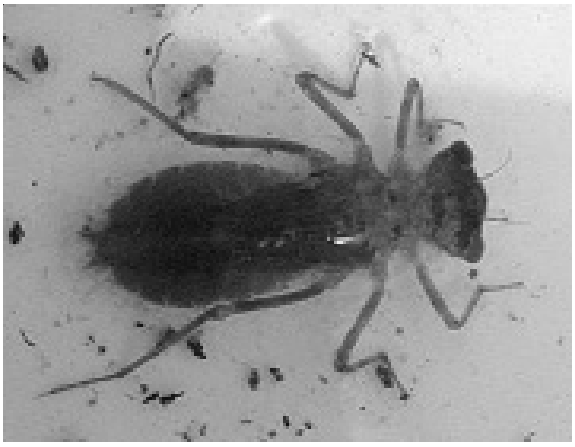

Fig.6: Dragonfly nymph.

ORDER:ODONATA

DRAGONFLIES AND DAMSELFLIES.

1. They are predators; the adults can significantly reduce mosquito populations by scooping them out of the water. They make a basket of legs for capturing insects during flight.
2. Their nymphs have protruding lower jaw to capture the prey. They devour mosquito larvae in water

ORDER: PLECOPTERA

STONEFLIES

1. Larvae and nymphs live beneath the stones of rivers and streams.
2. They take up to 3 yrs. to become adult and like mayflies they live for short time and die after breeding.
3. They are main food of trout and other fishes.
4. They are pollution indicators.

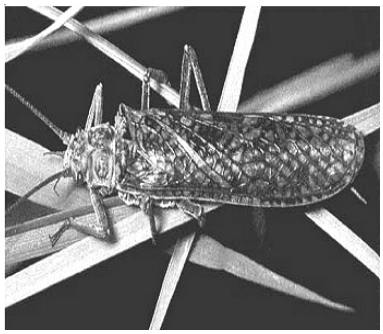

Fig.7: Stonefly adult.

ORDER:HEMIPTERAWATER STRIDER.1. They have modified legs for locomotion as well as for capturing the prey.2. Their legs have tiny water repellent hairs which help them to skate on the water.3. The tiny air bubbles held by the hairs help them to breath.

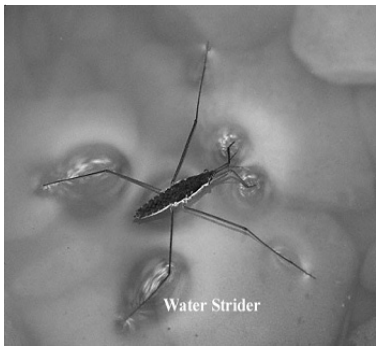

Fig.8: Water Strider adult.

ORDER:HEMIPTERAWATER BOATMAN.1. They swim using long hind legs.2. They collect air by hanging upside down below the water surface.3. They are main food of many predatory aquatic invertebrates such as water beetles, dragonfly larvae.

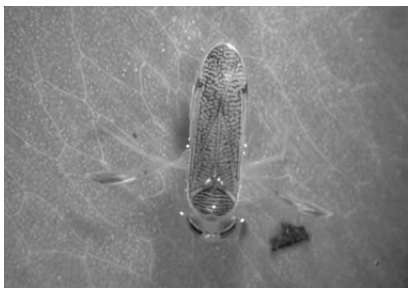

Fig. 9; Water boatman

ORDER:HEMIPTERA

GIANT WATER BUG.

1. They are big in size as described by their name.
2. They have sharp piercing mouth parts.
3. The bite of this bug is very painful.
4. They are predatory, feed on insects, tadpoles, small frogs etc

Fig.10: Giant water bug

ORDER: MEGALOPTERA

DOBSONFLY.

1. They are large in size up to few inches.
2. They have sharp mouth parts; the mandibles are long to capture the prey.
3. They are sensitive to water pollution and hence they act as pollution indicator.
4. They are favorite food of bass, catfish. Hence they are collected for fish bait.

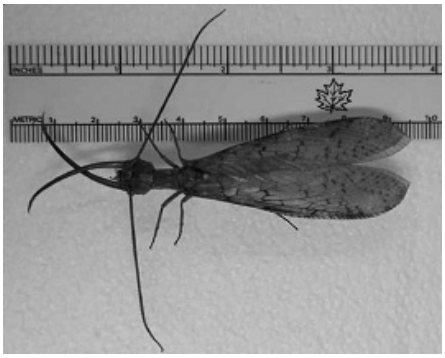

Fig.11: Dobsonfly adult.

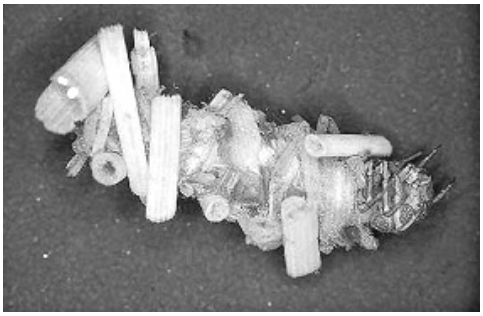

Fig.12: Caddisfly larva

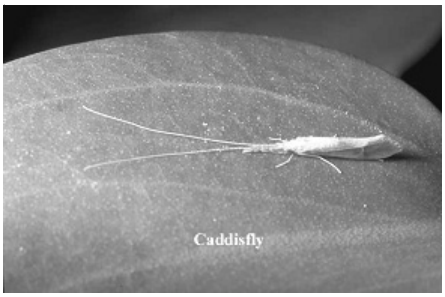

Fig. 13: Caddisfly adult

ORDER:TRICHOPTERA
CADDISFLIES.

1. Larva bears case on its back hence the name.
2. It uses the hooks at the end of the abdomen to hold the case.
3. The larvae live on dead plant matter, algae etc.
4. They are used as bait for catching fish.
5. They are also sensitive to water pollution.

ORDER:COLEOPTERA
WATER PENNY BEETLES.

1. Flat ,round body, found in streams on the underside of stones; all body parts hidden beneath dorsal sclerites; hair-like gills present on abdomen.

Fig. 14: Water Penny Beetles

ORDER:COLEOPTERA

WHIRLIGIG BEETLE

1. The front wings are modified into hardened covers which shield the rear wings from damage.
2. The whirligig beetles are very common and can often be found swimming together on the surface of calm water in large groups.
3. They have four eyes, enabling one pair to see below water surface and one pair above.

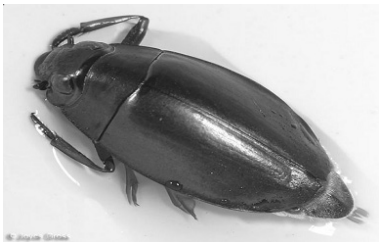

Fig.15: Whirligig beetle adult

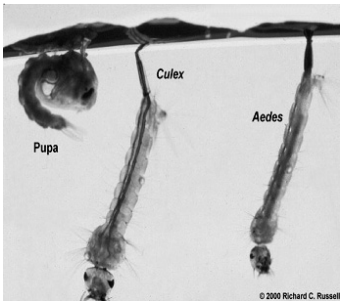

Fig.16: Mosquito larvae.

ORDER:DIPTERA
MOSQUITO LARVAE.

1. This order includes larvae that develop into adult which cause severe epidemic diseases in society.
2. They have modifications such as breathing tubes, silken tunnels & ventral suction cups.
3. They serve as food for other invertebrates.

Adaptations In Aquatic Insects

Aquatic insects show adaptations for respiration, locomotion and feeding.
The other life processes are same as that in other insects.

Adaptations For Respiration

1. **Cuticular respiration:-** The insects living in streams with high amount of oxygen have this adaptation. They have a thin integument that is permeable to oxygen.
2. **Biological gills**:- A biological gill is an organ which allows dissolved oxygen from water to diffuse in the organism's body. In insects gills are outgrowths of tracheae. Ex. Nymphs of Mayfly and stone fly. Dragonflies have internal biological gills.
3. **Breathing tubes:**-This is an extension of posterior spiracles as seen in mosquito larvae. This has opening at the end of siphon guarded by a ring of closely placed hairs. This hair close together to push the water pressure .Hence water entry is restricted.

Fig .17: Beetle with air bubble

4.. **Air bubbles:**-Some aquatic insects specially the beetles and bugs carry bubble with them; this collects oxygen molecules .hence the bubble act as physical gill.

5. **Plastrons**:- These are closely placed hydrophobic hairs that create "airspace" which trap air. The constant volume of air supply in plastron eliminates the need to go to surface. The insects who lack the ability to reach the surface or who are permanently inside water show this adaptation.

6. **Hemoglobin:**- Larvae of certain midges (family Chironomidae) known as bloodworms live in the muddy depths of ponds or streams where dissolved oxygen may be in short supply. Under normal (aerobic) conditions, hemoglobin molecules in the blood bind and hold a reserve supply of oxygen. Whenever conditions become anaerobic, the oxygen is slowly released by the hemoglobin for use by the cells and tissues of the body.

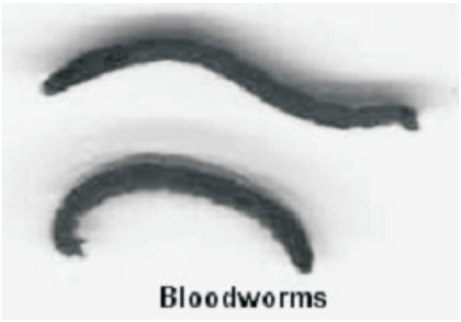

Fig.18: Chironomid larvae.

ADAPTATIONS FOR LOCOMOTION

WATER STRIDER.

1. Water striders have fine ,waterproof hairs that coat their body. They prevent water from soaking inside the body of insect. This breaks the surface tension.
2. This adaptation make them to walk as if they are skating on water.

DRAGONFLY NYMPH

1. A dragonfly nymph moves through the water by expelling water from it's abdomen just like a jet engine.

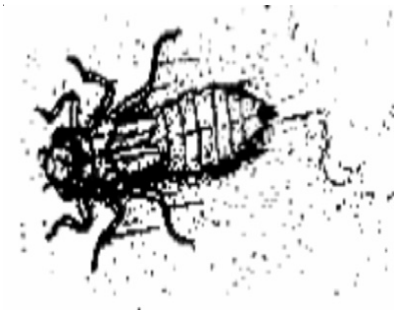

Fig.19: Nymph jetting water

WATER BOATMEN

1. Water boatmen swim through the water using their long hairy legs like the oars in a boat.

ADAPTATIONS FOR FEEDING

1. Feeding adaptation based upon what insects eat. Larval stages of aquatic insects are predatory.
2. Ex. Dragon fly and Damselfly nymphs have large pair of jaws for grabbing and holding its prey and placing it close to mouth .Its look like extra arm.
3. Water strider uses its sensitivity to motion and water vibrations to locate its prey. It grabs its prey and stabs it with sharp beak like structure and sucks its juices.
4. Water scorpion has forelegs adapted for grasping the prey.
5. Scrappers like mayflies are plant eaters. They have specialized mouth parts adapted for removing algae from surface of submerged plants.
6. Engulfers like water beetles eat their prey whole or in chunks.
7. Shredders like chironomid larvae break apart decomposing leaves into smaller pieces and eat them.
8. Dobsonfly has sharp mouth parts, their mandibles are long to capture the prey.
9. Caddisfly and chironomid larvae either have specialized structures in their bodies to collect detritus or build tiny nets to capture minute detritus particles.

ROLE OF AQUATIC INSECTS

1. Many aquatic insects are favourite food of commercially important fresh water fishes. Ex. mayfly, stonefly and caddisfly.
2. Aquatic insects like dragon fly control population of mosquitoes by feeding on their larvae.
3. Many species are sensitive to water quality and can be used as pollution indicators. Ex. Nymph of mayfly and stonefly.

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Mimicry In Insects

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Mimicry- A superficial resemblance of one organism to another or to natural objects among which it lives that secures that a selective advantage (as protection from predation).

Types Of Mimicry 1] Batesian mimicry - A harmless mimic resembles an unpalatable, dangerous, or otherwise protected model. By mimicking this way it gets protection from predators. For example, common crow which is non edible butterfly is mimicked by Great eggfly female, a palatable butterfly. A Plain Tiger butterfly is protected from attacks due to the unpalatable alkaloids ingested during the larval stages. The butterfly therefore flies slowly and leisurely, generally close to the ground and in a straight line. This gives a would-be predator ample time to recognize and avoid attacking it. It is specifically mimicked by different butterflies; one of them is Danaid eggfly female.

Common crow –Non Palatable (Model)

Great eggfly (female) – palatable (Mimic)

Great eggfly (male)

Plain tiger –Non Palatable(Model)

Danaid eggfly (female) - Palatable (Mimic)

Danaid eggfly (male)

Howerfly (Mimic)

2] Mullerian mimicry-Unrelated species that are distasteful or otherwise protected come to resemble each other. As both the model and the mimic are distasteful and toxic they get protection from the predators. Several species from several different orders may comprise a mimicry complex. The advantage is that the predators need only encounter one form to shun the entire complex.

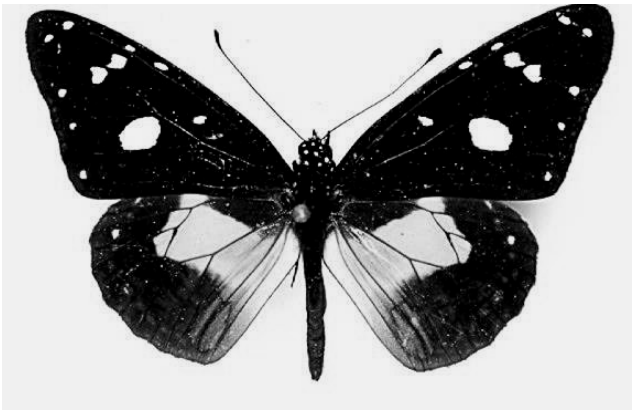
Honey bee (Dangerous model)

Examples—

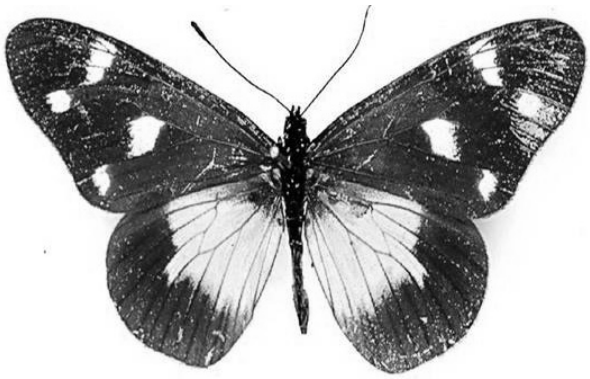
Monarchs are foul-tasting and poisonous due to the presence of *cardenolide aglycones* in their bodies, which caterpillars ingest as they feed on milkweed. The Viceroy butterfly is also unpalatable.Its' caterpillars sequester the *salicylic acid* in their bodies, which makes them bitter, and upsets predators' stomachs (earlier Viceroy was thought to palatable hence considered to be Batesian mimic of Monarch). Both forms advertise their unpalatability with bright colors and areas of high contrast on the skin or wings. This phenomenon is known as ***aposematism.***

The monarch (left) and viceroy (right) butterflies exhibiting Müllerian mimicry
Both Monarch and Viceroy are found in American continent expecially Central & North America.

Another example of Mullerian mimicry is as follows: Both the butterflies are unpalatable hence get protection.



Amauris albimaculata. **Family Nymphalidae, subfamily Danainae.**

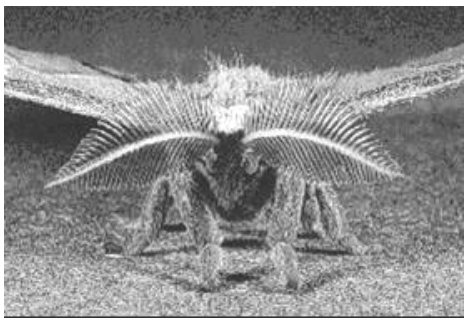


Acraea johnstoni confusa. **Family Nymphalidae, subfamily Acraeinae.**

3] Aggressive Mimicry

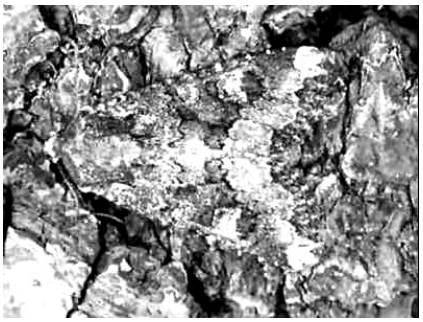
This describes predators which resembles a harmless species in order to lure prey.

When hunting, the spider walks like an ant. This spider actively interacts with ants near by. They may mimic ants as a trick to approach and prey on its ant model, i.e., aggressive mimicry



This is an example of aggressive mimicry, where a moth is mimicking Spider to scare the predator.

4) Camouflage The organism blends into its background and can be protected from predators by "**background resemblance**."

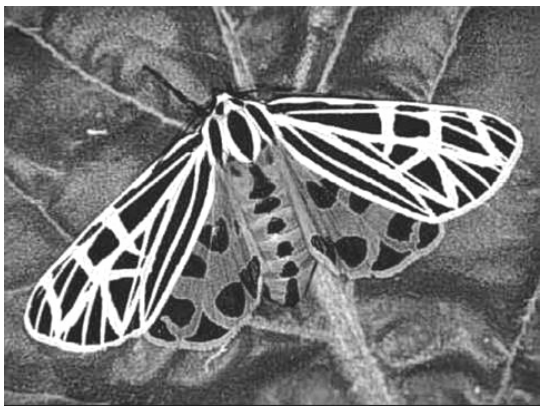


Spot the moth!

Wings and bodies that are dull and marked to resemble leaves, bark, soil or rocks colour, helps them hide from predators.

5) Warning Colors

Some moths are brightly colored as a warning to predators that they are distasteful (poisonous). Predators quickly learn to avoid eating moths that exhibit these bright colours. In fact, some non-poisonous moths are protected just by resembling the poisonous species!



Monarch larvae : Common defense mechanism used by monarch butterflies is their camouflaged coloration and bright colored spots to confuse predators. Bright colors act as signals warning other animals that they are poisonous.

More Examples : Hawk Moth Mimicry

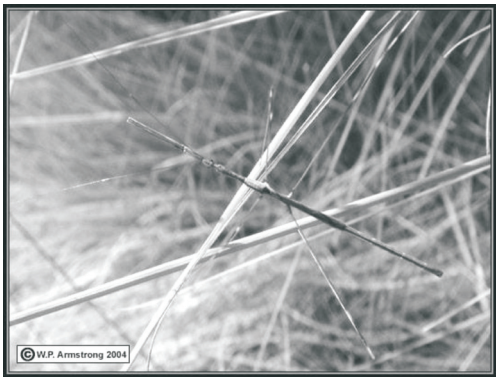
This moth caterpillar defends itself by mimicking a snake.

Bee Fly-Family Bombyliidae

Most of the flies in family Bombyliidae mimic wasps or bees

Leaf insects

It resembles the green leaves in colour. Body is flattened with leaf like wings and venation of wings resembles the leaf venation. Limbs are flattened and resemble the leaf stalk.



Stick insect- Locate where?

It is commonly called walking stick because it resembles the dry twig and walks on the dry branches of the plant. The body is slender and brown in colour

Stick worm (Geometrid Larva) :

It resembles dry twig in its resting position. Whenever disturbed, it clings to the branch with its hind legs (pseudo legs) and stands erect protruding its body in an angle to the branch, look as though it is a dry twig sticking out.It remains motionless until the threat is gone.

Dead leaf butterfly / Blue oak Leaf butterfly

When the wing is folded in resting position the under side of the wing resembles the dead leaf. When the wing is folded its shape resembles a leaf with a pointed tip and blunt stalk.